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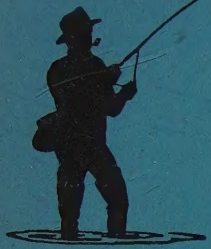

SPORT FISHERY ABSTRACTS

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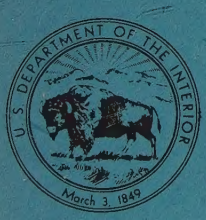
Abstracts 9156 - 9287



DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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BUREAU OF SPORT FISHERIES AND WILDLIFE

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SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 12, No. 2 Abstracts 9156-9287 1967

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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9156. Everhart, W. Harry, and Richard E. Cutting (Maine Dept. of Inland Fisheries and Game, Orono, Me.). 1967. THE PENOBSCOT RIVER — ATLANTIC SALMON RESTORATION: KEY TO A MODEL RIVER. Atlantic Sea Run Salmon Comm., Fisheries Building, Univ. of Maine, Orono, Me.

The Penobscot River basin contains some 1,604 streams and 625 lakes and ponds, the latter with a surface area of more than 250,000 acres. The major problems associated with restoration of the anadromous fish runs are man-made obstructions to free fish migration and pollution of the main stem waters. Based on the expected smolt production on the 9.16 million square yards of salmon spawning and nursery area, the annual run of salmon can be conservatively estimated at between 1200 and 3000 fish. Such a run could provide an angling harvest of between 180 and 750 salmon. The Bureau of Sport Fisheries and Wildlife plans a major hatchery to increase Atlantic salmon smolt production. Increased smolt stockings in the Penobscot River will augment natural runs. Little recreational use of the main Penobscot River is made at this time. Clean waters and good fishing will increase recreational opportunities. The development of these recreational opportunities must be accompanied by the acquisition of access so the public can make full use of the river's recreational potential. The Atlantic Salmon Restoration program provides a base for multi-purpose development of recreation along the Penobscot River.

9157. Forney, John L. (Dept. of Conservation, Cornell Univ., Ithaca, N. Y.). 1966. FACTORS AFFECTING FIRST-YEAR GROWTH OF WALLEYES IN ONEIDA LAKE, NEW YORK. New York Fish and Game Journal, 13(2): 146-167.

First-year growth of walleyes was determined from samples taken by seining and trawling at about weekly intervals in the summers of 1956 through 1964. Rate of growth in length gradually increased until walleyes reached a length of about 20 millimeters during the first or second week in June. In most years weekly growth increments from mid-June to mid-August were relatively constant, and growth rate decreased rapidly in September. Although population mean lengths increased between late fall and the following spring, this increase was probably caused by selective mortality of smaller walleyes in a year class rather than growth during winter. Length attained by July 1 was closely correlated with May-June air temperatures, but growth increments between July 1 and September 1 were not directly dependent on the air temperature regime in July and August. Growth rate in late summer tended to be rapid in years when walleyes fed on fish and lower when invertebrates were common in the diet. Although yellow perch were the principal forage fish found in walleye stomachs, growth in summer was not correlated with density of young perch. (Auth.)

9158. Jacobsen, Theodore V. (Dept. of Conservation, Cornell Univ., Ithaca, N.Y.). 1966. TRENDS IN ABUNDANCE OF THE MAYFLY (Hexagenia limbata) AND CHIRONOMIDS IN ONEIDA LAKE. New York Fish and Game Journal, 13(2): 168-175.

Analysis of bottom samples collected at three stations in Oneida Lake from 1956 to 1964 showed a decrease in the abundance of the mayfly (Hexagenia limbata) and an increase in chironomid populations. Oxygen depletion in the hypolimnion during periods of calm weather and possibly increased eutrophication of Oneida Lake were probably responsible for these population changes. (Auth.)

9159. Rothschild, Brian J. (Dept. of Conservation, Cornell Univ., Ithaca, N.Y.). 1966. OBSERVATIONS ON THE ALEWIFE (Alosa pseudoharengus) IN CAYUGA LAKE. New York Fish and Game Journal, 13(2): 188-195.

Observations on the seasonal movements, reproduction, phototaxis, and mass mortalities of the alewife were made at Cayuga Lake, New York, during 1960 and 1961. In Cayuga Lake the alewife winters in deep water and moves into the littoral area in the spring. This movement is accompanied by the onset of courtship behavior and then spawning. These reproductive activities are discussed. Fecundity estimates are given and hermaphroditism is mentioned. Positive phototactic responses of the alewife were noted except during the spawning period. The evidence on causes of mass mortalities in the alewife was reviewed, and it was concluded that variables other than temperature are involved. (Auth.)

9160. Poole, John C. 1966. GROWTH AND AGE OF WINTER FLOUNDER IN FOUR BAYS OF LONG ISLAND. New York Fish and Game Journal, 13(2): 207-220.

Otoliths from 2,400 adult and 620 juvenile winter flounder were collected by otter trawl and haul seine in several south-shore bays of Long Island (N. Y.). Measurements to annuli and otolith edge were analyzed to determine when annuli formed and their usefulness as criteria of age. Selected data were treated statistically, and it was found that the length attained at specific ages differed significantly between certain of the bays. Age composition of the population also differed significantly between the bays in all but one case. Both differences resulted in populations of generally larger-sized fish in the more eastern bays. (Auth.)

9161. Poole, John C. 1966. THE USE OF SALT-WATER COVES AS WINTER FLOUNDER NURSERY GROUNDS. New York Fish and Game Journal, 13(2): 221-225.

Data concerning the value of salt-water coves as nursery grounds for winter flounder were recorded in several parts of Shinnecock Bay and Peconic Bay where the shoreline had been little altered and was largely in a natural condition. At each location, paired sampling stations (one in the cove and one in the adjoining main bay) were established. In both bays, the coves were found to be a preferred habitat for young-of-the-year flounder. (Auth.)

9162. Poole, John C. 1966. A REVIEW OF RESEARCH CONCERNING SUMMER FLOUNDER AND NEEDS FOR FURTHER STUDY. New York Fish and Game Journal, 13(2): 226-231.

Current knowledge of the summer flounder and its fishery consist of catch data, length-weight relationships and findings from a few studies of life history. Some of this information is useful in describing the fishery, but to a great extent the data provide little that is necessary for evaluating the fishery's effects upon the resource. There is need for: (1) racial studies, initially limited to meristics; (2) a study of larvae and postlarvae by ocean sampling from Nantucket to Cape Hatteras to delineate the early nursery grounds; and (3) a cooperative study of the migratory patterns of immature summer flounder with exploratory efforts confined initially to Pamlico Sound and other appropriate areas of North Carolina. (Auth.)

9163. Loeb, Howard A. 1966. MARKING BROWN TROUT FRY WITH THE DYE, SUDAN BLACK B. New York Fish and Game Journal, 13(2): 222-223.

9164. Landrum, B. J. (Bur. of Commercial Fisheries Biological Lab., 2725 Montlake Blvd., East, Seattle, Wash.). 1966. BILATERAL ASYMMETRY IN PAIRED MERISTIC CHARACTERS OF PACIFIC SALMON. Pacific Science, 20(2): 193-202.

The presence, extent, and direction of bilateral asymmetries of lateral line scales, gill rakers, branchiostegal rays, and pectoral fin rays of sockeye, chum, and pink salmon were examined. Some asymmetries were found in all characters in each species. Asymmetries, considering all species combined, occurred in approximately 72% of the lateral line scale comparisons, 59% of the gill raker comparisons, 70% of the branchiostegal ray comparisons, and 26% of the pectoral fin ray comparisons. Bilateral variation in these characters was not conclusively related to sex of the specimens; however, some tendency toward greater asymmetry in branchiostegals of females was shown. Complete evaluation of this tendency will require further examination. Occurrences of asymmetries were evaluated in relation to the reliability of substituting counts from the opposite side when the chosen side was lost or severely damaged. Substitution of lateral line scales of sockeye salmon appeared to be feasible, but in chum salmon the right side counts were significantly greater. (Scale counts from pink salmon were not available, because of the extreme difficulty in obtaining reliable counts of the characteristically small scales.) Gill raker counts from sockeye salmon were found not to be interchangeable, as the right side counts significantly exceeded those of the left. In pink and chum salmon, bilateral variations in gill rakers appeared to be equal. Branchiostegal counts from the left sides of all species were significantly greater than those of the right. It was indicated that, for all species, pectoral fin ray counts from either side could be substituted reliably. (Auth.)

9165. Morrison, William J., and James E. Wright (Dept. of Botany, Penn. State Univ., University Park, Pa.). 1966. GENETIC ANALYSIS OF THREE LACTATE DEHYDROGENASE ISOZYME SYSTEMS IN TROUT: EVIDENCE FOR LINKAGE OF GENES CODING SUBUNITS A AND B. J. Exp. Zool., 163(3): 259-270.

Lactate dehydrogenase (LDH) isozymes of two genera within the family Salmonidae (Salvelinus and Salmo) were examined by acrylamide and starch gel electrophoresis. Those species examined contain three isozyme series involving five different kinds of subunits. The A-B series, believed to be homologous to LDH 1-5 in the majority of vertebrates, is found in nearly all tissues. Polymorphism for subunit B was discovered in Salvelinus fontinalis in which two kinds, B and B', are present within a number of inbred strains. Various crosses and backcrosses involving S. fontinalis and S. namaycush demonstrate that subunits A and B are each coded by different autosomal genes (LA and LB). A limited amount of test-cross data indicates linkage of these genes. Partial genetic analysis indicates that a second series of several LDH isozymes, largely restricted to the retina, involves a third subunit, C, in combination with B and to a lesser extent with A. A variant form of subunit C was found in Salmo trutta. Comparison of patterns of S. fontinalis and S. trutta and their hybrid seems to indicate that two additional subunits are involved in a third series of five isozymes found in the skeletal muscle of each species examined. (Authors)

9166. Berlin, J. D., and John Mark Dean (Biology Dept., Pacific Northwest Lab., Batelle Memorial Inst., Richland, Wash.). 1967. TEMPERATURE-INDUCED ALTERATIONS IN HEPATOCYTE STRUCTURE OF RAINBOW TROUT (Salmo gairdneri). J. Exp. Zool., 164(1): 117-132.

Electron microscopic examination showed that hepatocytes from rainbow trout (Salmo gairdneri) possess abundant amounts of rough endoplasmic reticulum. Particulate materials, presumably synthesized in the endoplasmic reticulum and transported to the Golgi apparatus, were more numerous in hepatocyte Golgi complexes of trout acclimated at 5° C compared to fish acclimated at 18° C. This temperature-induced structural modification is thought to reflect an increased secretory activity on the part of the hepatic cell as a result of the organism's adaptation to low temperature. (Authors)

9167. Cuerrier, Jean-Paul. 1966. THE LAKE STURGEON Acipenser fulvescens Raf. OF THE LAKE ST-PIERRE REGION DURING THE SPAWNING PERIOD. Naturaliste Can., 93(4): 279-334.

Commercial gill netting operations in the Lake St. Pierre area during 1947 and 1948 provided material for a study on some biological circumstances related to sexual maturity and spawning activities of lake sturgeon (Acipenser fulvescens Raf.) Data were obtained on size and age of sturgeon at the first maturation of the gonads. Almost twice as many mature males as females were caught during the spawning season and in the vicinity of spawning area; males reach sexual maturity at about 14 years and the females at about 25 years of age. The coefficient of condition was found to vary according to sex and to development of the gonads. Ovaries of mature sturgeon represented 21.5% of the total body weight while the testes represented only 8%. Data are presented on relative fecundity and the number of eggs produced according to size of individuals. Cycle in the development and the ripening of gonads and the intervals between two successive spawnings are discussed. (Auth.)

9168. Burress, Ralph M. (Missouri Conservation Comm., Columbia, Mo.). 1962. A QUANTITATIVE CREEL CENSUS ON TWO ARMS OF BULL SHOALS RESERVOIR, MISSOURI. Proc. Sixteenth Annual Conf. Southeastern Assoc. Game and Fish Commissioners.

A quantitative creel census was conducted for eight years on the Missouri portion of Bull Shoals Reservoir; on the Little North Fork Arm from 1953 through 1958, and on the White River Arm from 1955 through 1960. Sport fishing catch from the Little North Fork Arm averaged 39.2 pounds per acre (44.0 fish) over the six-year period. About 89.3 percent of the weight of fish taken was of predacious game fishes, including 49.6 percent (19.6 pounds per acre) of largemouth bass (Micropterus

salmoides), 9.2 percent (3.5 pounds per acre) of spotted bass (Micropterus punctulatus), and 23.1 percent (9.4 pounds per acre) of black crappie (Pomoxis nigromaculatus). Total fishing pressure per acre ranged from 35.5 hours (7.5 trips) to 105.3 hours (22.4 trips) with an average of 61.2 (12.6 trips). The rate of catch increased from 0.57 fish per hour in 1953 to 0.86 fish per hour in 1958. The percentage of successful anglers varied from 78.1 to 88.0 percent. Sport fishing catch from the census area in the Missouri portion of the White River Arm averaged 73.4 pounds per acre (75.8 fish) over the six-year period. About 63.4 percent of the weight of fish taken was predacious game fishes, including 11.5 percent (8.5 pounds per acre) of largemouth bass, 20.1 percent (15.0 pounds per acre) of white bass (Roccus chrysops) and 29.7 percent (21.7 pounds per acre) of white crappie (Pomoxis annularis) and black crappie. In addition, channel catfish (Ictalurus punctatus) comprised 21.6 percent (15.9 pounds per acre) and flathead catfish (Pylodictis olivaris) comprised 10.0 percent (7.9 pounds per acre) of the total harvest. Total fishing pressure per acre ranged from 53.3 hours (10.5 trips) to 113.9 hours (18.1 trips) with an average of 87.8 hours (16.3 trips). The rate of catch varied from 0.49 fish per hour in 1955 to 1.08 fish per hour in 1958. The percentage of successful anglers varied from 65.1 to 89.8 percent. Although the White River Arm produced more fish than the Little North Fork Arm, the catch of black bass in the former was less than half as great as in the latter. This is thought to result from greater competition offered by the much higher populations of crappie and white bass in the White River Arm. While creel composition of the two arms differed greatly, there was in both a very close relationship between harvest in pounds per acre and fishing pressure in pounds per acre. This indicates that fishing had not been heavy enough to affect the fish populations adversely. (Auth.)

9169. Rigler, F. H., and R. R. Langford (Dept. of Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1967. CONGENERIC OCCURRENCES OF SPECIES OF DIAPTOMUS IN SOUTHERN ONTARIO LAKES. Canadian Journal of Zoology, 45(1): 81-90.

The vertical distribution of adult calanoid copepods was studied in 100 lakes in southern Ontario. In addition to Epischura lacustris, Limnocalanus macrurus, and Senecella calanoides, seven species of Diaptomus were recorded. Diaptomus minutus and D. oregonensis, the commonest species, coexisted in 45% of the lakes. In 9% a third species was also present. Coexisting populations of D. minutus and D. oregonensis were not well separated by their vertical distribution, but a third species, if present, occurred in deeper water than these two. Size displacement does not contribute to the ecological separation of D. minutus and D. oregonensis. The difference in size between populations coexisting in the same lake is less than between populations living in separate lakes. (Authors)

9170. Thorson, Thomas B., Donald E. Watson, and C. Michael Cowan . 1966. THE STATUS OF THE FRESHWATER SHARK OF LAKE NICARAGUA. Copeia, No. 3. pp. 385-402.

Nineteen sharks collected from freshwater at several points on Lake Nicaragua and the Rio San Juan were all of the same species and indistinguishable from marine Carcharhinus leucas of the Atlantic. Minor differences previously thought to separate C. leucas from the lake shark proved to be invalid. Females had slightly longer gill slits, somewhat greater breadth of pelvic fin, and a longer abdominal region than males. Clasper length indicated that the onset of sexual maturity in males occurs when they are between 1,600 and 1,700 mm in total length. The classical theory or origin of the sharks from Pacific ancestry no longer appears tenable. An Atlantic origin is indicated by (a) strong evidence that the taxonomic affinities not only of the shark, but also of the sawfish and tarpon, are more pronouncedly with Atlantic relatives than with those of the Pacific, (b) recent evidence that Lake Nicaragua may never have been a part of the Pacific but opened originally to the Atlantic, (c) the fact that Lake Nicaragua drains into the Caribbean Sea by a large, broad river, and (d) all three of the large, otherwise marine types of fish occurring in the lake are species that habitually congregate in brackish water and frequently move up rivers. Evidence that the sharks are not landlocked includes the following facts: (a) they

are abundant the full length of the river, (b) barges drawing from one to three feet of water regularly negotiate the river (including all of the rapids) in both directions, (c) sharks were observed both below and above the three major rapids as well as actually in the rapids, most of them headed upstream. (Authors)

9171. Dieffenbach, William H. 1966. TAXONOMY OF THE CUTTHROAT TROUT (Salmo clarkii Richardson) OF THE SOUTH PLATTE DRAINAGE, COLORADO. Copeia, No. 3. pp. 414-424.

Taxonomy and selected life history of 50 cutthroat trout (Salmo clarkii Richardson) from four high altitude tributary streams of the South Platte drainage, Colorado, were studied. Study areas were selected to determine the existence of fish that represent the native greenback cutthroat trout (S. c. stomias Cope). The life history study indicated that the cutthroat trout in the South Platte drainage are either isolated from other trout or in association with brook trout (Salvelinus fontinalis Mitchill). Morphological measurements were of little value in separating cutthroat trout into subspecies. Counts of scales above lateral line, scales in lateral line, scales two rows above lateral line, hyoid teeth, and spotting distribution provided the best information. On the basis of anatomical counts, cutthroat trout from Blackhollow Creek, Larimer County, Colorado, seem to represent the greenback cutthroat trout. Scale counts of 42 above the lateral line, 138 in the lateral line, 194 two rows above the lateral line, and a hyoid teeth count of 7 characterized this population. (Auth.)

9172. Vandermeer, John H. 1966. STATISTICAL ANALYSIS OF GEOGRAPHIC VARIATION OF THE FATHEAD MINNOW, Pimephales promelas. Copeia, No. 3. pp. 457-466.

Eight characters were measured on specimens of Pimephales promelas from 54 localities. Each character was subjected to an analysis of variance or covariance, a Student-Newman-Keuls multiple comparisons test, and a trend surface analysis. Each character is discussed separately with respect to the multiple comparisons test and the trend surface analysis. Relative strength of the regional trend and its possible biological importance are discussed and comments are made on infraspecific nomenclature. (Auth.)

9173. Gerald, Jerry W. 1966. FOOD HABITS OF THE LONGNOSE DACE, Rhinichthys cataractae. Copeia, No. 3. pp. 478-485.

Samples of longnose dace, Rhinichthys cataractae, and bottom organisms were taken approximately every two weeks from July 9 to September 5, 1963, from a 56,000 ft^2 riffle of the Yellowstone River near Emigrant, Montana. The fish were divided into three size groups (0-49 mm, 50-69 mm, and 70-100 mm) for the analysis of digestive tract contents. The frequency occurrence of all organisms in the fish digestive tracts, percent volume and average number of insects were considered for each of these groups. Baetidae had the highest percent volume and the highest average number in each size group except that Tendipedidae had the highest average number in the 50-69 mm size group. Algae had the highest frequency occurrence in the 0-49 mm group. Tendipedidae was highest in the 50-69 mm group, and Baetidae and Tendipedidae were equally high in frequency occurrence in the 70-100 mm group. Seasonal variation of food was about the same in all three size groups. Forage ratios were calculated for each size group. Baetidae had the highest forage ratio with 3.9, 5.0, and 6.8 in the small, medium, and large size groups, respectively. The only other family with a ratio greater than 3.0 was Simuliidae which had 5.3 in the 70-100 mm group but less than 1.0 in the other two groups. The ratios of Baetidae, Siphlonuridae, and Simuliidae were highest for the largest size group of fish while the ratios of Tendipedidae and all Plecoptera were highest for the smallest size group of fish. While some of the bottom organisms were too large for the fish to eat, the ones found in the digestive tract contents were generally those that were most available and abundant. (Auth.)

9174. Gould, William R. 1966. CUTTHROAT TROUT (Salmo clarkii Richardson) X GOLDEN TROUT (Salmo aquabonita Jordan) HYBRIDS. Copeia, No. 3. pp. 599-600.

9175. Myers, George S. 1966. DERIVATION OF THE FRESHWATER FISH FAUNA OF CENTRAL AMERICA. Copeia, No. 4. pp. 766-773.

The nature, composition, and evolution of Central American freshwater fish groups are discussed in relation to the history and derivation of the faunal elements It is concluded that the entire area between the Isthmus of Tehuantepec and eastern Papama was and always had been devoid of primary (obligatory) freshwater fishes prior to the very late Tertiary. Instead, secondary freshwater fishes evolved in this area during the Neogene and perhaps for a longer period, the Poeciliidae having probably had a longer history within the area than the Cichlidae. In the late Tertiary a very few North American immigrants entered the area from the north, and towards the end of the Pliocene the closing of the very ancient Panama sea gap permitted an influx of South American primary types. Most of these have not yet gotten past Costa Rica, but a few aggressive characids have reached Guatemala or southern Mexico and one has reached Texas. It follows that the rich South American primary freshwater fish fauna could not have been originally derived from or through Central or North America, and continental drift (not here discussed in detail) is suggested to explain South American-African similarities. (Auth.)

9176. Miller, Robert Rush. 1966. GEOGRAPHICAL DISTRIBUTION OF CENTRAL AMERICAN FRESHWATER FISHES. Copeia, No. 4. pp. 773-802.

The distribution of freshwater fishes in Central America is reviewed. Major parts of the region, especially in Honduras and Nicaragua, have yet to be explored ichthyologically, and systematic revision of important groups, notably the cichlids, is long overdue. The continental area from the Isthmus of Tehuantepec to the Colombian border contains approximately 456 species, of which over 75% comprise the Cyprinodontidae, Poeciliidae, Cichlidae, and marine invaders (peripheral fishes); about one-third of the latter (57 species) have taken up more or less permanent residence in fresh water. There are 104 primary species in 10 families, 165 secondary forms in 6 families, and 187 peripheral species distributed among 30 families (nearly half of the latter are ariids, atherinids, gerrids, and gobies). Poeciliids and cichlids are particularly rich and diverse, together comprising 139 species. Characins are numerous only in the Panamanian region, into which they and five South American catfish families have recently penetrated. Except for gars, no North American family has reached beyond northern Guatemala. There are no non-ostariophysan primary fishes in the area. Although our knowledge of the fish fauna approaches adequacy only in the Guatemalan and Panamanian regions, an attempt is made to delimit fish provinces. The best known, the Usumacinta assemblage of southeastern Mexico and northern Guatemala, has been a strong center of evolution. The marked differences between the fishes of this area and those of the Isthmian province, in Costa Rica and Panama, emphase that Middle American fishes do not comprise a coherent faunal unit. Other provinces are the impoverished Chiapas-Nicaraguan and the San Juan, the latter notable chiefly for the cichlids of the Great Lakes of Nicaragua. The highlands of southeastern Mexico, Guatemala, and Honduras comprise an ancient land mass with a meager fish fauna in which the primitive cyprinodontid genus Profundulus has evolved. The Middle American fauna, from which most of Panama should be excluded, is characterized by: (1) the adaptive radiation of the probably autochthonous Poeciliidae; (2) great diversification of the genus Cichlasoma, including the evolution of the derived genera Petenia, Neetroplus, and Herotilapia; (3) the likely origin and speciation of Bramocharax; (4) the occurrence of numerous freshwater species of marine origin, a development strongly influenced by (5) the paucity of primary freshwater fishes. (Auth.)

9177. Baker, Alan N. 1966. FOOD OF MARLINS FROM NEW ZEALAND WATERS. Copeia, No. 4. pp. 818-822.

Stomach contents of 55 marlins from northern New Zealand were analyzed: 38 striped marlin Tetrapturus audax (Phillipi), 10 black marlin Istiompax indicus (Cuvier), and 7 blue marlin Makaira nigricans Lacépede. These fishes feed largely on 18 species of teleosts (12 families), and 2 species of cephalopods. (Auth.)

9178. Richards, William J. 1966. SYSTEMATICS OF THE PERCID FISHES OF THE Etheostoma thalassinum SPECIES GROUP WITH COMMENTS ON THE SUBGENUS Etheostoma. Copeia, No. 4. pp. 823-838.

The subgenus Etheostoma is diagnosed and redescribed, and relationships of the species within this subgenus are discussed. Etheostoma thalassinum from the Santee River System and E. inscriptum from the Altamaha, Savannah, and Edisto river systems are shown to be closely related. E. swannanoa, from the headwaters of the Tennessee River system, exhibits several specialized features: absence of palatine teeth, reduction in number of prevomerine teeth, and presence of a basal orange-red band in the spinous dorsal fin. These features among others relate this group to E. blennioides. Auth.)

9179. Bay, Ernest C. 1966. ADAPTATION STUDIES WITH THE ARGENTINE PEARL FISH, Cynolebias bellottii, FOR ITS INTRODUCTION INTO CALIFORNIA. Copeia, No. 4. pp. 839-846.

The cyprinodontid annual fish, Cynolebias bellottii Steindachner, was successfully field-reared and propagated at Riverside, California, with eggs and adult fish subjected to climatic conditions which were the reverse of those in its native habitat (Brazil, Argentina, and Uruguay). Egg production during mid-summer (July-August) was appreciably less than during autumn; and during the winter embryonic development was delayed for as long as 10 months. Less than 0.1% of overwintering eggs hatched when flooded after 7-1/2 months (May 24, 1965). (Auth.)

9180. Collette, Bruce B. 1966. A REVIEW OF THE VENOMOUS TOADFISHES, SUBFAMILY THALASSOPHRYNINAE. Copeia, No. 4. pp. 846-864.

The subfamily Thalassophryninae differs from the other two subfamilies of Batrachoididae (Batrachoidinae and Porichthyinae) in having two hollow dorsal spines and a hollow opercular spine that connect with venom glands. Thalassothia Berg is shown to be a synonym of Thalassophryne Günther. The eastern Pacific Daector Jordan and Evermann differs from the western Atlantic Thalassophryne in having discrete glands between the bases of the upper pectoral fin rays and in having more precaudal and caudal vertebrae and more second dorsal and anal fin rays. Three species of Daector are recognized: reticulata Günther; gerringi Rendahl; and dowi Jordan and Gilbert (including depressa Hildebrand). Six species of Thalassophryne are recognized: amazonica Steindachner; megalops Bean and Weed; maculosa Gunther (including quadrizonatus Eigenmann and wehekindi Fowler); nattereri Steindachner (including branneri Starks); punctata Steindachner; and montevidensis Berg (including platensis Devincenzi). The presence or absence of the axillary and pectoral fin glands are considered to be of generic value. Thalassophryne, Amphichthys, and Halophryne lack both glands. Daector, Aphos, Porichthys, and Batrachoides lack the axillary gland but have discrete pectoral fin glands. Batrachomoeus and Sanopus have the axillary gland and lack pectoral fin glands. Opsanus has both types of glands. Opsanus astrifer is placed in Sanopus along with O. barbatus. (Auth.)

9181. Salmon, Michael, and Howard E. Winn (Dept. of Biological Sciences, De Paul Univ., Chicago, Ill.). 1966. SOUND PRODUCTION BY PRIACANTHID FISHES. Copeia, No. 4. pp. 869-872.

In this report the sound producing mechanism in two species of priacanthid fishes is described. The results of physical analysis of the sounds are also presented. It was found that sounds were produced via two bilateral muscles, each attached to the air bladder and the inside of the body wall.

9182. Weisel, George F. 1967. THE PHARYNGEAL TEETH OF LARVAL AND JUVENILE SUCKERS (Catostomus). Copeia, No. 1. pp. 50-54.

Counting the most ventral tooth as number one, the sequence of attachment of the first teeth to the pharyngeal arches of larval Catostomus catostomus and C. macrocheilus is 2,3,1,4,5. Additional teeth form dorsally in succession and replacement is rapid. Ten percent of the pharyngeal arches develop a single outer tooth on one or both arches. Inasmuch as the tooth is not constant in position or

specific for a stage in its appearance, it is considered a disturbance in the normal process of tooth replacement rather than a recapitulation of a multi-rowed ancestral form. The shape of the teeth during successive replacements implies a common ancestry for cyprinids and catostomids and indicates that catostomids are at least as specialized as cyprinids in this respect. (Auth.)

9183. Birdsong, Ray S., and Ralph W. Yerger. 1967. A NATURAL POPULATION OF HYBRID SUNFISHES: Lepomis macrochirus X Chaenobryttus gulosus. Copeia, No. 1. pp. 62-71.

A relatively high incidence of hybrid sunfishes in Ocheese Pond, west Florida, provided material for morphological and ecological studies of the hybrids with their parental stocks, the bluegill (Lepomis macrochirus), and the warmouth (Chaenobryttus gulosus). A comparison of meristic, morphometric and osteological characters revealed a striking intermediacy of the hybrid between the two parental types. Computation of a hybrid index value utilizing 11 characters for 27 specimens indicated a value of 47 (50 represents exact intermediacy). The hybrids showed no greater variability for most characters than did the parents, but hybrid vigor was evident in the greater body depth, caudal peduncle depth, and intensity of color. The sex ratio among hybrids showed a disproportionately large number of males. Although seemingly normal gametes were found among four individuals, gonads were poorly developed in the majority of specimens. One experimental cross, male bluegill X female warmouth, was successful in the laboratory, but the young survived only eight days. Hybridization in Ocheese Pond is probably a result of the close breeding association of the two species, caused by a dearth of preferred bluegill nesting sites. (Authors)

9184. Greenhood, Edward C., and David J. Mackett. 1967. THE CALIFORNIA MARINE FISH CATCH FOR 1965. Calif. Dept. of Fish and Game Fish Bulletin 135. pp. 1-42.

9185. Jensen, Paul T., and Phillip G. Swartzell. 1967. CALIFORNIA SALMON LANDINGS 1952 THROUGH 1965. Calif. Dept. of Fish and Game Fish Bulletin 135. pp. 43-57.

9186. Pinkas, Leo. 1966. A MANAGEMENT STUDY OF THE CALIFORNIA BARRACUDA Sphyraena argentea Girard. Calif. Dept. of Fish and Game Fish Bulletin 134. 58 p.

From 1958 through 1960, the barracuda sportfishery cropped 10 different year-classes (1949 through 1958) ranging in age from 2 to 9 years. Five- and 6-year-old fish dominated the catches in 1958 and 1959, while in 1960, there was a dramatic change to 3- and 4-year-old fish. Barracuda off northern Baja California and off southern California intermix and are essentially one population. Results of the 1959 marking program revealed a decided northward movement of barracuda in the summer, strongly associated with rising water temperatures, and a probably southward migration in the fall. The number of barracuda caught per-angler-day from the sportfishing partyboats ranged from a low of 0.24 in 1956 to a high of 3.08 in 1959. There has been a positive correlation between the abundance of barracuda off southern California in any given year and the average daily sea surface temperatures at Scripps pier in the same year. (From auth. summ.)

9187. Smith, Gerald Ray. 1966. DISTRIBUTION AND EVOLUTION OF THE NORTH AMERICAN CATOSTOMID FISHES OF THE SUBGENUS Pantosteus, GENUS Catostomus. Miscellaneous Publications, Museum of Zoology, Univ. of Michigan, No. 129. 133 p.

The osteology, external anatomy, and internal anatomy of fishes of the genus Pantosteus and related suckers are analyzed for information on the levels of relationship within that section of the family Catostomidae. Pantosteus is seen to be a specialized product of Catostomus evolution and Pantosteus plebeius and C. columbianus are found to be intermediate between the two genera. It is concluded that Pantosteus should rank taxonomically as a subgenus of Catostomus—an arrangement independently supported by the widespread hybridization between the two groups.

The relationships of C. columbianus are with Pantosteus. Analysis of the distribution and variation of populations of Pantosteus led to construction of descriptions, comparisons, keys, range statements, distribution maps, and synonymies for the species. Six species are recognized: C. columbianus of the Columbia River drainage below the falls of the Snake River, and the Fraser River; C. platyrhynchus of the Great Basin and the Columbia, upper Green, Missouri, Saskatchewan, and Fraser rivers; C. discobolus of the Colorado River drainage above Grand Canyon, the upper Snake River drainage, and the northern Bonneville basin; C. clarki of the Colorado River drainage and Pleistocene connectives below Grand Canyon; C. santaanae of the Santa Ana system of streams, southern California; and C. plebeius of the drainage systems of the upper Rio Grande, Lake Guzman, Rio Nazas and associated streams, Rio Mezquital, Rio Piaxtla, and upper Rio Yaqui. It is suggested that the early evolution of Pantosteus involved a columbianus ancestor in the north, a central ancestral form in the Great Basin-Colorado Plateau area, and a plebeius ancestor in the southern parts of the range, as sections of one of the products of Catostomus evolution. (From auth. summ.)

9188. Kerswill, C.J. (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N.B., Canada). 1967. STUDIES ON EFFECTS OF FOREST SPRAYINGS WITH INSECTICIDES, 1952-63, ON FISH AND AQUATIC INVERTEBRATES IN NEW BRUNSWICK STREAMS: INTRODUCTION AND SUMMARY. J. Fish. Res. Bd. Canada, 24(4): 701-708.

This introduces a series of papers on fisheries studies associated with operational and experimental forest spraying, mainly with DDT-in-oil insecticide. It outlines: (a) the history of the spray program developed to counteract an outbreak of the spruce budworm (Choristoneura fumiferana) in New Brunswick; (b) administrative arrangements for developing and coordinating a reasonable research and management program concerning the affected fisheries, mainly for Atlantic salmon (Salmo salar); (c) highlights of field and laboratory studies on effects of insecticide sprayings on caged young salmon and trout (Salvelinus fontinalis), on aquatic insect production, on feeding habits of native young salmon, and on population levels of young salmon. (Auth.)

9189. Kerswill, C.J., and H.E. Edwards (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N.B., Canada). 1967. FISH LOSSES AFTER FOREST SPRAYINGS WITH INSECTICIDES IN NEW BRUNSWICK, 1952-62, AS SHOWN BY CAGED SPECIMENS AND OTHER OBSERVATIONS. J. Fish. Res. Bd. Canada, 24(4): 709-729.

The survival of young Atlantic salmon and eastern brook trout, held in cages and free-living, was observed in New Brunswick streams inside and outside forested areas sprayed operationally and experimentally from aircraft with DDT and other insecticides for budworm control. DDT-in-oil in a single application at 1/2 lb/acre caused heavy loss of underyearling salmon and parr within 3 weeks. DDT-in-oil at 1/4 lb/acre had no apparent short-term effects on salmon parr, but killed many underyearlings; two applications 10 days apart were about as harmful as a single application at 1/2 lb/acre. DDD at 1/2 lb and 1/4 lb/acre, and malathion at 1/8 lb/acre, were no more harmful to young salmon than DDT at 1/4 lb/acre. Replacing Stearman airplanes with larger aircraft in operational spraying and associated changes in spraying procedure sometimes caused heavy fish losses even for single applications of DDT at 1/4 lb/acre. Experimental spraying of phosphamidon-in-water at 1 lb/acre had no apparent harmful effects on young salmon and trout. Observations at a counting fence across the Northwest Miramichi 12 miles below the lower boundary of the forested area sprayed with DDT at 1/2 lb/acre in 1954 showed extensive killing of suckers and cyprinids; also, the numbers of these species moving through the fence was abnormally low for several years after spraying. Wild young salmon were found dead in streams when autumn water temperatures approached freezing after June sprayings of watersheds with DDT. (Authors)

9190. Elson, P. F. (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N. C., Canada). 1967. EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS. J. Fish. Res. Bd. Canada, 24(4): 731-767.

When DDT-in-oil was sprayed over large tracts of New Brunswick forest some of the spray got into drainage systems lying in the spray zones. As a result, many young salmon were killed and stocks were endangered. Most New Brunswick salmon spend 3 years in rivers before migrating to sea as smolts. The young fish can conveniently be divided into three size-groups, which are roughly comparable to each year of age. The groups are: underyearlings, small parr (over 1 year old but 10 cm and under from tip of snout to tip of extended tail fin), and large parr. Wild young salmon in unsprayed and sprayed streams were assessed for numbers in each size-group, abundance being expressed as population index = average number per 100 yards of stream bottom. After spraying DDT at 1/2 lb/acre young salmon of all size-groups were found in noticeably low numbers as compared with unsprayed situations. Underyearlings were only 2-10% as abundant (index reduced from 24 in places not affected by spray to less than 1 in most sprayed places), small parr only 30% (index reduced from 20 to 6), and large parr only 50% (index reduced from 12 to 6) as abundant. After spraying DDT at 1/4 lb/acre underyearlings were only about 50% as abundant as with no spraying; small parr were about 80% as abundant and large parr were affected hardly at all. Two applications of DDT at 1/4 lb/acre was followed by low numbers of underyearlings, similar to those observed with a single application at 1/2 lb/acre. No equivalent data for parr are available but other information indicates effects similar to a single spraying with 1/2 lb DDT/acre. Downstream transport of the DDT-in-old mixture was an important factor in extending the harmful effects 30 or more miles below spray zones. Delayed mortality followed 4 to 6 months after the early mortality described above. It was associated with the onset of winter cold. It may have removed a large proportion of parr which survived early mortality but quantitative measurements of this factor were not made on wild populations. Reductions in numbers of young salmon were followed by declines in numbers of adults taken in fisheries and returning as spawners. With no spraying in subsequent years, promptness of recovery of young salmon populations depended primarily on abundance of parent stock. (Auth.)

9191. Ide, F. P. (Dept. of Zoology, Univ. of Toronto, Toronto, Ont., Canada). 1967. EFFECTS OF FOREST SPRAYING WITH DDT ON AQUATIC INSECTS OF SALMON STREAMS IN NEW BRUNSWICK. J. Fish. Res. Bd. Canada, 24(4): 769-805.

Sampling of emerging aquatic insects by cage-traps on a 24-hour basis showed the effects on the stream fauna of spraying forests with DDT at 1/2 lb/acre in June. Except for a few individuals that presumably emerged from unaffected pupae and nymphs, there was an interval of several weeks after spraying when no emergence occurred. From about the middle of August, however, large populations of very small insects, mainly chironomids, emerged in the spray year. The year after spraying, as compared with the spray year, there was an increased variety including some larger species. In following years there was further recovery by increase in larger forms through reproduction from residual small populations. The caddisflies recovered more slowly than other groups. After a single application of spray the fauna had practically recovered qualitatively in 2 or 3 years in some groups but usually not for 4 years or more in caddisflies. With a further similar spray applied within 3 years a reduction occurred equal in severity to that of the original spraying. From the standpoint of feeding of the young salmon, significant facts are: (a) the severe reduction in the bottom fauna of larvae and nymphs of all sizes in the first weeks after spraying; (b) the large populations of small larvae, mainly chironomids, developing in late summer of the spray year and so available to fry; (c) increasing numbers of larger insects the year after spraying and subsequent years. (Auth.)

9192. Keenleyside, Miles H. A. (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N. B., Canada). 1967. EFFECTS OF FOREST SPRAYING WITH DDT IN NEW

BRUNSWICK ON FOOD OF YOUNG ATLANTIC SALMON. J. Fish. Res. Bd. Canada, 24(4): 807-822.

Food in stomachs of young Atlantic salmon from the Northwest Miramichi River, N. B., changed following aerial DDT spraying of the surrounding watershed. Before spraying, young salmon typically ate immature aquatic insects, fry (underyearlings) concentrating on Diptera and small Ephemeroptera, and parr (overyearlings) on Diptera, Trichoptera, and all sizes of Ephemeroptera. Reduction of all aquatic insects by DDT was soon followed by resurgence of Chironomidae and other Diptera, and surviving fry fed heavily on these; parr fed on Diptera but also ate snails, worms, and fish, previously unimportant in their diet. Five years after the last spraying the prespray complexity of young salmon food was being approached. Trichoptera were slowest of the major fish-food types to reappear in stomachs. In fry stomachs Ephemeroptera, and in parr stomachs Ephemeroptera and Trichoptera, were relatively more abundant than in the surrounding stream fauna. Greater availability of these insects and active selection by fish are discussed as possible causes of these relationships. (Auth.)

9193. Grant, C. D. (Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N. B., Canada). 1967. EFFECTS ON AQUATIC INSECTS OF FOREST SPRAYING WITH PHOSPHAMIDON IN NEW BRUNSWICK. J. Fish. Res. Bd. Canada, 24(4): 823-832.

No harmful effects on aquatic insects were detected in two New Brunswick streams after forest spraying with phosphamidon (1/2-1 lb/acre) in 1962 and 1963. Comparison of one pre-spray and two post-spray series of bottom samples showed no reduction in number of orders (and families in the case of Diptera) and no abnormal decline in the number of individuals. In numbers and variety of insects emerging daily into stream cages and of insects drifting onto vertical screens in the streams, no changes were attributable to phosphamidon. (Auth.)

9194. Pauley, Gilbert B. (Biology Dept., Battelle Memorial Inst., Pacific Northwest Lab., Richland, Wash.). 1967. PRESPAWNING ADULT SALMON MORTALITY ASSOCIATED WITH A FUNGUS OF THE GENUS Dermocystidium. J. Fish. Res. Bd. Canada, 24(4): 843-848.

A serious outbreak of mortalities occurred among adult salmon held in the Priest Rapids Dam spawning channel in November 1965. Gross examination revealed small, white cysts on and in the gill filaments of otherwise normal-appearing fish. Approximately 25% of the 5,000 mature adult salmon in the channel died prior to spawning from this disease caused by a fungus identified as the genus Dermocystidium. This is the first record of an epidemic among fish of North America associated with Dermocystidium. The primary cause of death appeared to be anoxia due to subacute inflammation and granulation of the gill tissue. A description of the histopathology associated with these parasites is given. Chondrococcus columnaris, a pathogen of warm-water fishes, was present as a secondary invader on the gill filaments of several salmon and an unknown fungal or yeast-like organism was present in the testes of the male fish examined. (Auth.)

9195. Weber, Douglas, and George J. Ridgway (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1967. MARKING PACIFIC SALMON WITH TETRACYCLINE ANTIBIOTICS. J. Fish. Res. Bd. Canada, 24(4): 849-865.

Diets containing tetracycline antibiotics were fed to hatchery populations of Pacific salmon. Subsequent examination of bone samples from these populations indicates that the tetracyclines are deposited permanently in the skeletal structure, are readily detectable after a period of rapid growth, and do not affect growth or survival. The most satisfactory and consistent marks were obtained by feeding 250 mg of tetracycline antibiotic per kilogram of body weight per day for 4 consecutive days. (Authors)

9196. Pauley, Gilbert B., and Roy E. Nakatani (Biology Dept., Battelle Memorial Inst., Pacific Northwest Lab., Richland, Wash.). 1967. HISTOPATHOLOGY OF "GAS-BUBBLE" DISEASE IN SALMON FINGERLINGS. J. Fish. Res. Bd. Canada, 24(4): 867-871.

Chinook salmon fingerlings were diagnosed as having "gas-bubble" disease. Gross symptoms were similar to those described by other investigators. The histopathology associated with this disease has not been previously reported. The following 10 tissues and organs were examined: gills, liver, spleen, heart, kidney, intestine, stomach, roof of the mouth, skin, and muscle. All exhibited histopathological changes with the exception of the hearts and stomachs, which did not differ from the control fish. The most striking pathological changes occurred in the roof of the mouth of all fish examined. (Authors)

9197. Bidgood, B.F., and A.H. Berst (Univ. of Guelph, Guelph, Ont., Canada). 1967. PHENOTYPIC CHARACTERISTICS OF RAINBOW TROUT IN THE GREAT LAKES. J. Fish. Res. Bd. Canada, 24(4): 887-891.

9198. Margolis, L. (Fish. Res. Bd. Canada Biol. Sta., Nanaimo, B.C., Canada). 1967. Triaenophorus crassus PLEROCERCOIDS IN SOCKEYE SALMON SMOLTS FROM THE KVICHAK RIVER SYSTEM, ALASKA. J. Fish. Res. Bd. Canada, 24(4): 893-894.

9199. Dollar, Alexander M., Edward A. Smuckler, and Raymond C. Simon (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. ETIOLOGY AND EPIDEMIOLOGY OF TROUT HEPATOMA. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 1-17.

9200. Simon, Raymond C., Alexander M. Dollar, and Edward A. Smuckler (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. DESCRIPTIVE CLASSIFICATION ON NORMAL AND ALTERED HISTOLOGY OF TROUT LIVERS. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 18-28.

Wax-plate reconstruction of non-neoplastic trout liver has revealed an architecture consisting of cell plates and true hepatic cords. The former predominate and are 2 cells in thickness. Thickness of cell plates alone is reported to be an unreliable criterion of hyperplasia in histological preparations since the plane of sectioning may often bisect the two rows of cells within cell plates. Diameters of nuclei in normal liver cells have been found to increase as body weight increases. Evidence is presented to suggest direct continuity between hepatocytes and cells of the terminal biliary system. Active hematopoiesis is reported to be a typical feature of the normal liver. Tumor prevalence approaching 100 percent is found to be attained in 1 year among groups fed a "positive control" diet. Detailed constitution of this diet is provided in addition to complete formulation of diets which did not produce hepatic alterations in 24 months of continuous administration. Feeding of these diets has provoded tumorous and non-tumorous hatchery fish which are compared with wild trout. A classification is proposed to aid in providing a descriptive record of liver alterations. (Authors)

9201. Wolf, H., and E.W. Jackson (California Dept. of Fish and Game, Sacramento, Calif.). 1967. HEPATOMA IN SALMONIDS: THE ROLE OF COTTONSEED PRODUCTS AND SPECIES DIFFERENCES. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 29-33.

9202. Coates, J.A., T.J. Potts, and H.L. Wilcke (Ralston Purina Company, Checkerboard Square, St. Louis, Mo.). 1967. INTERIM HEPATOMA RESEARCH REPORT. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 34-38.

9203. Yasutake, William T., and Robert R. Rucker (Bur. of Sport Fisheries and Wildlife, Western Fish Disease Lab., Seattle, Wash.). 1967. NUTRITIONALLY INDUCED HEPATOMAGENESIS OF RAINBOW TROUT (Salmo gairdneri). In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 39-47.

9204. Sinnhuber, R.O. (Dept. of Food Science, Oregon State Univ., Corvallis, Oreg.). 1967. AFLATOXIN IN COTTONSEED MEAL AND LIVER CANCER IN RAINBOW TROUT. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 48-55.

9205. Wales, J.H. (Dept. of Food Science, Oregon State Univ., Corvallis, Oreg.). 1967. DEGENERATION AND REGENERATION OF LIVER PARENCHYMA ACCOMPANYING HEPATOMAGENESIS. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 56-59.

9206. Scarpelli, Dante G. (Laboratory of Cellular Pathology, Ohio State Medical School, Columbus, Ohio). 1967. ULTRASTRUCTURAL AND BIOCHEMICAL OBSERVATIONS ON TROUT HEPATOMA. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 60-71.

9207. Novelli, G.D. (Oak Ridge National Lab., Union Carbide Nuclear Co., P.O. Box Y, Oak Ridge, Tenn.). 1967. AMINO ACID INCORPORATION IN RAT AND TROUT LIVER. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 72-77.

9208. Halver, John E. (Bur. of Sport Fisheries and Wildlife, Western Fish Nutrition Lab., Cook, Wash.). 1967. CRYSTALLINE AFLATOXIN AND OTHER VECTORS FOR TROUT HEPATOMA. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 78-102.

9209. Ashley, Laurence M. (Bur. of Sport Fisheries and Wildlife, Western Fish Nutrition Lab., Cook, Wash.). 1967. HISTOPATHOLOGY OF RAINBOW TROUT AFLATOXICOSIS. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 103-120.

9210. Wogan, G.N. (Dept. of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass.). 1967. ISOLATION, IDENTIFICATION, AND SOME BIOLOGICAL EFFECTS OF AFLATOXINS. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 121-129.

9211. Newberne, Paul M. (Dept. of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass.). 1967. BIOLOGICAL ACTIVITY OF THE AFLATOXINS IN DOMESTIC AND LABORATORY ANIMALS. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 130-144.

Reports from field outbreaks and from laboratory experiments have shown some notable differences as well as similarities among species in regard to the hepatotoxic effects of aflatoxin. The induction of malignant hepatocarcinomas, now adequately confirmed in several laboratories, points up the potential seriousness of the problem. We now feel that there is adequate experimental evidence available to link earlier field outbreaks of certain noninfectious diseases in domestic animals and dogs to aflatoxin and that the choline-deficiency tumor of rats reported earlier was complicated by mold toxins. The chemical assay combined with the duckling bioassay provide a means of permitting the continued use of the valuable peanut meal protein by screening aflatoxin from the edible foodstuffs destined for human consumption and livestock feeds. (Auth.)

9212. Phelps, Richard A. (National Cottonseed Products Assoc., Memphis, Tenn.). 1967. AFLATOXINS IN FEEDS—A REVIEW. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 145-159.

Chemistry, biological effects, occurrence and measurement of a class of mold toxins known as aflatoxins have been reviewed. Aflatoxins have a known structure, affect many species of animals, exert their primary effect on the liver

in a similar but not identical manner, are extremely toxic and carcinogenic, have appeared in most areas of the world, are easily removed from vegetable oils but continue to be a problem in feedstuffs, such as peanut meal. Prevention of aflatoxin contamination by proper control of moisture and temperature, especially in the rapid drying of peanuts after removal from the ground, should be urged. Research is continuing to develop methods of removal from contaminated products. The vast majority of food grade peanuts are free of aflatoxins, and it appears to be only a matter of time until all feeds can be made free of these recently discovered compounds. (Auth.)

9213. Goldblatt, Leo A. (Southern Regional Research Lab., P.O. Box 19687, New Orleans, La.). 1967. DETECTION AND ELIMINATION OF AFLATOXIN. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 160-174.

9214. Falk, Hans L. (Carcinogenesis Studies Branch, National Cancer Institute, Bethesda, Md.). 1967. POTENTIAL HEPATOCARCINOGENS FOR FISH. In: Trout Hepatoma Research Conference Papers. Bureau of Sport Fisheries and Wildlife Research Report 70. pp. 175-192.

9215. Stewart, R. Keith, William Marcus Ingram, and Kenneth M. Mackenthun (Fed. Water Pollut. Control Admin., R.A. Taft Sanitary Eng. Center, Cincinnati, Ohio). 1966. WATER POLLUTION CONTROL. WASTE TREATMENT AND WATER TREATMENT. SELECTED BIOLOGICAL REFERENCES ON FRESH AND MARINE WATERS. U.S. Dept. of the Interior, Federal Water Pollution Control Administration. 126 p.

Selected biological references concerning water pollution control, waste treatment, and water treatment.

9216. Rabe, F.W. 1967. AGE AND GROWTH OF RAINBOW TROUT IN FOUR ALPINE LAKES. Northwest Science, 41(1): 12-22.

Rainbow trout from lakes X-26 and X-49 grew to lengths of 10-12 inches in 2 years, while growth increments leveled off the third year. Four-year-old rainbows from X-24 continued to grow about an inch per year, whereas trout from X-25 showed no increase in either length or weight from the previous season. Some four-year-old trout from X-49 were about six times heavier and 12 inches longer than rainbows of the same age from X-25. Rainbow trout were thought to have winter-killed in 1964 in X-26, the highest study lake. Growth differences were attributed to variations in standing crops of previously established brook trout and cutthroat trout populations. (Auth.)

9217. Swanson, George A. (Bur. of Sport Fisheries and Wildlife, North Central Reservoir Investigations, Yankton, S.D.). 1967. FACTORS INFLUENCING THE DISTRIBUTION AND ABUNDANCE OF Hexagenia NYMPHS (EPHEMEROPTERA) IN A MISSOURI RIVER RESERVOIR. Ecology, 48(2): 216-225.

Abundance of bottom organisms in Lewis and Clark Lake was measured by transect-station and randomly-stratified sampling methods. Samples were collected with modified orange-peel and Ekman dredges, and cores were used to delineate bottom types. Hexagenia nymphs have reached an abundance on the inundated flood plain comparable to populations in natural lakes with suitable habitat. Length frequencies of nymphs, plotted at monthly intervals throughout the summer, suggest a 2-year life cycle for the major portion of the populations. Concentrations of the fall progeny (1-10 mm) indicate that the early distribution of nymphs is a function of imago activity during oviposition. Distribution of the overwintering nymphs differs considerably from that of the previous fall. Evidence of migration from densely populated shore areas was observed. An interaction of depth, wind, current, and bottom type is influential in redistributing the population. (Auth.)

9218. Cantwell, Robert. 1966. SAVING TROUT FROM DROUGHT. Sports Illustrated, 25(17): 66-67.

The Forest Service erected 1-1/5 miles of snow fence in the high mountains of Colorado to see what it would cost and to determine the effect on summer stream flows. It was calculated that the fence retained an additional 20.9 acre-feet of water in the Lake Creek watershed. Plans of the Forest Service now call for a total of 13 miles of fence to help maintain the summer flow of Colorado's mountain streams.

9219. Hanks, James J., and Harold D. Kube. 1966. INDUSTRY ACTION TO COMBAT POLLUTION. Harvard Business Review, 44(5): 49-62.

At least $275 billion will be spent on pollution control during the next 34 years. Industry is responsible for over half of the present air and water pollution: the public will continue to demand corrective action. Private industry can well direct a considerable effort to provide the services needed and to obtain a major share of the monitary benefits assured for those services. At least $110 billion will be spent for control of water pollution by industry and municipalities. There is an important job to be done and industry still has the opportunity to do it.

9220. Schumann, George O., and Herbert C. Perkins (Bur. of Commercial Fisheries, California Current Resources Lab., La Jolla, Calif.). 1966. A JAR FOR CULTURING SMALL PELAGIC MARINE ORGANISMS IN RUNNING WATER DURING SHIPBOARD OR LABORATORY STUDIES. J. Cons. perm. int. Explor. Mer., 30(2): 171-176.

Some difficulties encountered at sea when incubating pelagic fish eggs and cultivating small marine invertebrates in running water may be overcome by utilizing porous polyethylene filters to replace bottoms in glass jars. The proportionally large drainage area achieved allows water to be circulated through the jar without outflow currents carrying organisms to the bottom. Jars stand in a continuously replenished water bath thus fluctuations in water temperature caused by ambient air temperature are very low. Pre-filtration of seawater was necessary in areas of high phytoplankton concentration because detritus clogged the 60-70 micron sized pores in the jar filters. Construction details of jars, pre-filter and plumbing systems are described. (Authors)

9221. Alexander, R. McN. (Dept. of Zoology, Univ. College of North Wales, Bangor). 1967. THE FUNCTIONS AND MECHANISMS OF THE PROTRUSIBLE UPPER JAWS OF SOME ACANTHOPTERYGIAN FISH. J. Zool., Lond., 151(Pt. 1): 43-64.

Photographs of Pterophyllum and Gasterosteus feeding indicate that they suck food into their mouths by expansion of the buccal and opercular cavities. The premaxillae are protruded as the mouth opens, and remain protruded as it closes. The mechanisms whereby these movements can be performed, by these and by more generalized acanthopterygians, are described. It is shown that the palatines of generalized acanthopterygians are so arranged as to prevent retraction of the premaxillae when the mouth is closed with the buccal cavity expanded. It is estimated, from rough measurements on a few species, that a teleost cannot suck into its mouth food that is further from its mouth opening than about one-quarter of the length of its head. It is shown that protrusion of the premaxillae can be useful in getting the mouth opening close to food that is to be sucked in, especially when it is to be taken from the bottom. The possible advantages of closing the mouth with the premaxillae protruded are discussed. The origin of the acanthopterygian protrusible mechanism is discussed. (Auth.)

9222. Mansell, W. D. 1966. BROWN TROUT IN SOUTHWESTERN ONTARIO. Ontario Fish and Wildlife Review, 5(2): 3-8.

In 1960 the stocking of brown trout was discontinued. After 5 years of natural reproduction a study was made to determine distribution, populations and growth. Twenty-three streams were sampled with electrofishing gear, and 565 brown trout and 126 brook trout were examined and liberated. Brown trout averaged 2.6 inches at 6 months, 6.5 inches at 1 year, 9.8 inches at 2 years, 15.3 inches at 3 years, and 16.8 inches at 4 years. The brown trout was particularly wary and creeled only by the more skillful anglers.

9223. Frye, John. 1967. FISH SPIES IN THE SKY. Sportfishing, 3(7): 22-23, 38-39.

Methods used in research efforts to determine the relationship between surface temperature and distribution of migratory marine game fish. Studies are being made along both the Atlantic and Pacific coasts. An infra-red thermometer, mounted on a camera tripod, scans the ocean surface from the port hatch of an airplane. Temperatures it picks up are recorded on a strip chart. One man observes fish and other marine life while another operates the recorder and notes on the strip the observations. At specific points on the grid of the flight, drift bottles containing reply cards are dropped from the plane. An effort is being made to also develop a key to facilitate the identification of all types of marine animals from the air. Definite temperature tolerances for fish have not yet been established, but trends are beginning to develop. Temperature charts of this work are now available.

9224. Hansen, Donald F. (Illinois Natural History Survey, Urbana, Ill.). 1966. STOCKING AND SPORTFISHING AT LAKE GLENDALE (ILLINOIS). Ill. Nat. Hist. Survey Bull. 29(2): 105-158.

The quality of plug, fly and worm fishing in an 82-acre lake was observed for 5 years after a stocking of adult largemouth bass, Micropterus salmoides, and adult bluegills, Lepomis mcarochirus, at rates of 0.9 and 2.6 fish per surface acre, respectively, and for 4 years after a stocking of fingerling and adult bass and bluegills at the heavier rates of 27 and 41 fish per acre. Stockings were contaminated by relatively small populations of warmouth, Chaenobryttus gulosus, and green sunfish, Lepomis cyanellus. Bluegill fishing was best following the lighter stocking because of the faster growth of new bluegill broods. Bass fishing, however, was better after the heavier stocking due to excellent growth of the stocked fish and presence of a larger number of extra fast growing members of new bass broods (the so called "cannibals"). In the 5 years after the lighter stocking, bass fishing was good only for a few hours on the day the lake was first opened to angling, and after the heavier stocking bass fishing declined sharply after one good season. The generally poor bass fishing of the first period and decline during the second period resulted from the stunting and short life spans of most individuals comprising the new bass broods. The standing fish crop in pounds per acre observed 6 years after the first stocking was 1/2 to 1/3 that of neighboring farm ponds. Low fall temperatures and silt that settled over fish killed with rotenone are described as hindrances to determination of the standing crop. (Auth.)

9225. Pfeiffer, Peter W. 1966. A GUIDE TO 18 OF KENTUCKY'S STATE-OWNED LAKES. Kentucky Dept. of Fish and Wildlife Resources, Frankfort, Ky. 58 p.

Since 1958 fishery biologists of the Department of Fish and Wildlife Resources have been studying many of the physical, chemical and biological aspects of Kentucky's state-owned lakes. A certain amount of that knowledge can and will aid the fisherman (provided he uses it properly) in his quest of our finny friends. The purpose of this guide, is to present to the fisherman certain characteristics of each lake in a manner and form that will be both interesting and useful.

9226. Carter, Luther J. 1967. ESTUARIES: WILL CONGRESS SAVE THEM FROM ENCROACHMENTS? Science, 156(3783): 1717, 1719-1720.

Legislative efforts to save estuarine areas are being opposed by commercial interests who suspect that their profits may be sacrificed to the welfare of the Great Blue Heron and other romantic causes. Dredging and filling constitute a danger against which no effective legislative response has been made. Some of these are the result of a speculator's desire to buy cheap marsh, fill it, and sell it at a high price for residential or industrial development. During 1964, 1965, and 1966, the U.S. Army Corps of Engineers received about 5,000 applications for dredging and filling permits. The U.S. Fish and Wildlife Service raised objections to 193. Of these, 147 were granted with the concurrence of the Fish and Wildlife Service, 8 were denied, and 38 were granted over continuing objection of the Fish and Wildlife Service. The Corps of Engineers tend to share the boosters' belief that, while ducks and scenic beauty are desirable, they should not hold up Progress.

9227. Raney, Edward C., and Timothy Zorach (Div. of Biological Sciences, Cornell Univ., Ithaca, N. Y.). 1967. Etheostoma microlepidum, A NEW PERCID FISH OF THE SUBGENUS Nothonotus FROM THE CUMBERLAND AND TENNESSEE RIVER SYSTEMS. The American Midland Naturalist, 77(1): 93-103.

This moderate-sized, brightly colored, sexually dimorphic darter is described from Kentucky and Tennessee. Its closest relative is E. moorei of the White River System, Arkansas. Sympatric species of Nothonotus include E. camurum, tippecanoe, and rufilineatum. E. maculatum, which has been taken nearby, has been confused with microlepidum. Like other species of Nothonotus, details in color and pattern are important characters. E. microlepidum has more fin rays and scales than related species, and, in smallness of body scales, is similar to the upstream populations of E. camurum in the highlands of eastern Tennessee. It is found in fast riffles over gravel and rubble. (Authors)

9228. Hubbs, Clark, Ronald C. Baird, and Jerry W. Gerald (Dept. of Zoology, Univ. of Texas, Austin, Texas). 1967. EFFECTS OF DISSOLVED OXYGEN CONCENTRATION AND LIGHT INTENSITY ON ACTIVITY CYCLES OF FISHES INHABITING WARM SPRINGS. The American Midland Naturalist, 77(1): 104-115.

The cycles of killifishes of the genus Crenichthys were studied, using trap capture rates and sound volumes as indices of activity. When other factors are optimal, the fish are less active in the dark than in the light, regardless of clock time. A variety of environmental parameters could probably alter the cycles when any one factor is unfavorable. Low concentrations of dissolved oxygen result in reduced activity. Such reduction can be effected at one site where dissolved oxygen is limited, while nearby populations are active in localities that have more dissolved oxygen. Apparently at 32° C activities are adversely affected by oxygen supplies below 2 ppm. (Authors)

9229. Thomas, M. L. H. (Fish. Res. Bd. Canada, Biological Sub-Station, Ellerslie, P. E. I., Canada). 1966. BENTHOS OF FOUR LAKE SUPERIOR BAYS. Canadian Field-Naturalist, 80(4): 200-212.

Explorations for larval lamprey in four bays in Canadian Lake Superior during 1959 to 1961 produced large collections of benthos and bottom living fishes. Benthic fauna of this area is little known and therefore every effort was made to identify that which was collected. This information is tabulated. (Auth.)

9230. Power, G. (Dept. of Biology, Univ. of Waterloo, Waterloo, Ontario, Canada). 1966. ANALYSIS OF THE MOVEMENT AND GROWTH OF JUVENILE BROOK TROUT (Salvelinus fontinalis) FROM ROTENONE COLLECTIONS TAKEN IN THE NABISIPI RIVER AND VICINITY, QUEBEC. Canadian Field-Naturalist, 80(4): 213-223.

Eleven collections of trout were made in Grand Ruisseau, a small stream, 7 miles long, entering the sea. In view of the poor rate of recovery of marked trout in this stream, it was concluded that rotenone samples are of little value for estimating mortality rates of fry or describing population density unless combined with some technique for estimating recovery rates. The causes of slow growth in small streams like Grand Ruisseau is uncertain. It would seem factors other than temperature, food, space and cover limit growth of brook trout in small streams.

9231. Hemmings, C. C. 1966. OLFACTION AND VISION IN FISH SCHOOLING. J. Exper. Biology, 45(3): 449-464.

The behavior of individual roach was observed in a horizontal linear gradient of species odor. No attempt was made to analyze the odor involved. The behavior of roach, grey mullet and Chromis was studied in the presence of (a) a mirror, or (b) a second fish behind a clear plastic sheet. Roach showed nearly as strong a response to attractant species odor as to the repellent "Schreckstoff". The relative strengths of responses to directional visual images and non-directional odor gradients were compared. Short-term and long-term declines in the strength of the response to odor occurred. Observation of a "two-fish school" suggested that a system of exploratory, returning and following tendencies co-ordinated schooling behavior.

Isolation of roach for a period of 20-25 weeks caused enhancement of the olfactory reaction but completely disrupted the visual response. It is suggested that school structure is maintained by balanced attractive and repulsive "forces"; the attraction modalities involved are vision by day and olfaction by night, and the repulsion modality is the lateral line sense. (Auth. summ.)

9232. Hemmings, C. C. 1966. THE MECHANISM OF ORIENTATION OF ROACH, Rutilus rutilus L. IN AN ODOUR GRADIENT. J. Exper. Biology, 45(3): 465-474.

The behavior of individual roach was tested in a horizontal linear gradient of roach odor. Tests with a chemical model suggested that the gradient was logarithmic. The swimming speed of the fish was not directly related to odor concentration but was low when fish swam into decreasing concentration and much higher in the opposite direction. This does not support an ortho-kinesis. Turning was more frequent at the high concentration end of the gradient which the fish "preferred". This is the reverse of klino-kinesis. It is suggested that orientation is by spatial and temporal comparison of intensities, that speed is related to change in stimulation and that variation in turning serves to maintain fish at high odor concentrations. (Auth. summ.)

9233. Cairns, John, Jr. 1967. LIVING WITH OUR NATURAL WATER SYSTEMS. Scientist and Citizen, 9(2): 28-33.

We are seriously overloading and damaging the aquatic ecosystem which would otherwise have the capacity to restore the quality of our waters after the introduction of wastes. Some of this damage may be irreversible, or require many years before the ecosystem can again function fully. The variations in our waters, and the complexities of the interactions of natural and man-made factors are so great, that there is no simple way of restoring this system and keeping it functioning. An obvious first step is the setting of water quality standards. On a long range basis, the natural systems themselves point to the need for regional water resource planning, of which standards are a part. The standards could then reflect the unique nature and individual variation of the environment in various regions of the country. Information feedback would be an essential ingredient of a flexible system. Waste disposal limits could reflect the effect upon the ecosystem receiving the waste.

9234. Bardach, J. E., J. H. Todd, and R. Crickmer (School of Natural Resources, Univ. of Michigan, Ann Arbor, Mich.). 1967. ORIENTATION BY TASTE IN FISH OF THE GENUS Ictalurus. Science, 155(3767): 1276-1278.

Fish of the genus Ictalurus can find distant chemical clues by means of taste alone, and they exhibit true gradient searching in the absence of a current. Neither unilateral nor bilateral deprivation of the sense of smell impaired their searching ability, but unilateral deprivation of taste receptors which are spread over body and barbels of the animals caused pronounced circling toward the intact side. The relation of swimming paths of the fish to the chemical in the water suggested that comparisons of concentrations were made in time and space. (Authors)

9235. Crosby, D. G., and R. K. Tucker (Agricultural Toxicology and Residue Research Lab., Univ. of California, Davis, Calif.). 1966. TOXICITY OF AQUATIC HERBICIDES TO Daphnia magna. Science, 154(3746): 289-290.

Accurate determination of the acute toxicities of a series of 16 aquatic herbicides to Daphnia magna reveales that several of them may present a hazard to food-chain microfauna whether the compounds are environmentally destroyed or not. (Authors)

9236. Powers, Charles F., and Andrew Robertson. 1966. THE AGING GREAT LAKES. Scientific American, 215(5): 100, 102, 104.

The five Great Lakes constitute the greatest reservoir of fresh water on earth, 5,457 cubic miles. Lake Superior is the world's largest fresh-water lake. The eutrophication of the lakes is being tremendously accelerated by pollution.

9237. Chiappetta, Jerry. 1966. SALMON SUCCEED IN GREAT LAKES. Field and Stream, 70(8): 10-15.

Michigan released 800,000 5-inch coho salmon in tributaries of the Great Lakes in the spring of 1966. By autumn enough salmon had already been caught by sport and commercial fishermen to indicate that this species may be the answer in converting the now abundant alewife population of the lakes to more desirable fish flesh. Lake trout are still being stocked but they spawn in the lakes and the young trout are fed on by the alewife. It is planned to release about a million more coho salmon in the spring of 1967 and again in 1968 to cover the three-year life cycle of this species. Michigan also plans to introduce chinook salmon into its tributary streams.

9238. Anonymous. 1967. FIRST CHINOOK PLANTED. Michigan Conservation Dept. Topics, 4(11): 3.

Michigan's first plantings of about 850,000 small chinook (king) salmon smolts were carried out in three northern streams the second week in May in the Department's latest effort to rebuild a spectacular sport fishery in the Great Lakes. A total of 500,000 chinook were planted in the little Manistee River, Manistee County; 300,000 in the Muskegon River, Newaygo County; and 50,000 in the Big Huron River, Baraga County.

9239. Van Valin, Charles C. (Bur. of Sport Fisheries and Wildlife, Fish-Pesticide Research Lab., Denver, Colo.). 1966. PERSISTENCE OF 2,6-DICHLOROBENZONITRILE IN AQUATIC ENVIRONMENTS. In: Organic Pesticides in the Environment. Advances in Chemistry Series, Number 60. pp. 271-279.

In two experiments 2,6-dichlorobenzonitrile was added to aquatic systems, and the residue levels were followed for about 6 months. A granular formulation applied to a farm pond at 0.6 ppm produced highest residues in water and fish about 2 weeks following treatment whereas vegetation and soil samples had the highest levels within 1 or 2 days. Residues were still measurable after 188 days. In ponds treated with a wettable powder formulation at 10, 20, and 40 ppm, residues in water and fish were highest within 3 days after treatment. The concentration in water 11 days after treatment was about 2% of the three-day level. Fish whole-body residues dropped nearly as fast but were still measurable at 112 days. (Auth.)

9240. Gideiri, Yousif Babiker Abu (Dove Marine Lab., Cullercoats). 1966. THE BEHAVIOUR AND NEURO-ANATOMY OF SOME DEVELOPING TELEOST FISHES. J. Zool., Lond., 149(Pt. 2): 215-241.

This investigation relates the ontogenetic development of observable behavior to the underlying co-ordinating and conducting systems in teleosts. It is based on a study of the eggs of seven species, fertilized artificially. The onset of behavior was marked by the heart beat; this started in separate regions which became connected and developed a rhythm. It was followed by non-rhythmic contractions of the body musculature, the resulting flexures becoming alternating or serial and cephalo-caudal. Movements of the pectoral fins, jaws and opercula were first performed as part of the axial musculature of the body; later they became independent and co-ordinated. There was an increasing tendency towards stability and efficiency in the development of response to tactile, chemical, vibrational, feeding, rotational and light stimulation. Results of extirpation experiments and examination of the developing nervous system suggested that the embryonic life can be divided into four stages: myogenic, neurogenic, reflexogenic and swimming, respectively. In the first, movement started in connection with some activity of the protoplasm; in the second, somatic motor neurons reached muscle fibres and took over the initiation of contraction; in the third, stimulation would produce responses in the form of a reflex arc; and, in the fourth, there was elaborate and precise reactions to stimulation. These stages in the development of behavior showed a well-defined correlation with the successive structural patterns of the developing nervous system. (Auth.)

9241. Srivastava, L. P. (Dept. of Zoology, Univ. College of Swansea, Swansea). 1966. THREE NEW LEECHES (PISCICOLIDAE) FROM MARINE SHORE FISHES (COTTIDAE) IN BRITISH WATERS. J. Zool., Lond., 150(Pt. 3): 297-318.

Two species of Malmiana (=Ottoniobdella) are recorded from Cottus bubalis on the Yorkshire coast. Malmiana bubali sp. n. has six eyes, but no metameric markings or posterior ocelli. Malmiana yorki sp. n. has four eyes and 14 posterior ocelli. The body in both is somewhat flattened, but their other characters clearly place them in this genus, the history of which is reviewed. Heptacyclus myoxocephali sp. n. was found on Myoxocephalus scorpius from Millport. It lacks eyes and surface markings. The genus Heptacyclus is characterized by 7(14) annulation and has dorsal, lateral and ventral lacunae, and separate post-caeca, but lacks pulsatile vesicles and segmental communications between lacunae. (Auth.)

9242. Sinha, V. R. P., and J. W. Jones (Dept. of Zoology, Univ. of Liverpool). 1966. ON THE SEX AND DISTRIBUTION OF THE FRESHWATER EEL (Anguilla anguilla). J. Zool., Lond., 150 (Pt. 3): 371-385.

This paper reports the result of an examination of about 8,000 eels mainly from various parts of several Welsh rivers made to try and find out whether the distribution of eels was determined by their sex. Contrary to the popular belief, males and females were found living together in freshwater and in brackish water. The organ of Syrski, which was supposed to be diagnostic of the male sex has been found ambiguous in nature and not always a precursor of a male gonad. The consequent difficulties of the identification of the sex of moderately sized eels is discussed and it is suggested that the abnormal sex ratio, as reported by some investigators, is related to the obscure structure of the organ of Syrski and the fact that gonad differentiations may not occur until the fish is quite large. The possibility that other factors such as selective fishing and a sex differential in growth rates and duration of freshwater life may also be contributory factors is discussed. It is suggested that the environment plays little part in sex determination. (Authors)

9243. Alexander, R. McN. 1967. MECHANISMS OF THE JAWS OF SOME ATHERINIFORM FISH. J. Zool., Lond., 151(Pt. 2): 233-255.

The Atheriniformes is an order of teleost fish which consists of the Atherinoidei (sand smelts, etc.), Cyprinodontoidei (tooth-carps) and Exococtoidei (half-beaks, etc.). Some of its members have protrusible jaws and some do not. Photographs have been taken of two species of Cyprinodontoidei feeding, to discover how they use their jaws, which are protrusible. The anatomy and mechanisms of the jaws of these and of various other Atheriniformes have been studied. The terminology of the kinematics of machines is used in a general discussion of the mechanisms of teleost jaws. Anatomical similarities between the jaws of Acanthopterygii, Cyprinoidei and Atheriniformes are noted and discussed. (Auth.)

9244. Munro, J. L. (Zoology Dept., Univ. College of Rhodesia and Nyasaland, Salisbury, Rhodesia). 1967. THE FOOD OF A COMMUNITY OF EAST AFRICAN FRESHWATER FISHES. J. Zool., Lond., 151(Pt. 3): 389-415.

Quantitative data on the food of the fishes inhabiting Lake McIlwaine, Rhodesia, show that the feeding of the dominant species in this community (Clarias gariepinus (Burchell), Hydrocynus vittatus (Castelnau), Tilapia melanopleura Dumeril, Tilapia mossambica Peters, Tilapia macrochir Boulenger, Labeo altivelis Peters, and Gnathonemus macrolepidotus (Peters)) covers a wide spectrum, and almost all elements of the potential food supply are utilized. Exceptions are noted, however, and the introduction of the Indian carp, Catla catla (Cuv. & Val.), is advocated in order to utilize the large blooms of phyto- and zoo-plankton. The oligochaete, Branchiura cf. sowerbyi, which forms over 50% of the benthic biomass is also not utilized as a source of fish food. However, no fish species is known to feed on oligochaetes to any large extent. Predation by the Tigerfish, Hydrocynus vittatus, is shown to have severe effects upon recruitment to the valuable Tilapia fishery, and the reduction of the abundance of H. vittatus by means of selective fishing techniques is advocated. (Auth.)

9245. Colgrove, D. J., and J. W. Wood. 1966. OCCURRENCE AND CONTROL OF Chondrococcus columnaris AS RELATED TO FRASER RIVER SOCKEYE SALMON. Internatl. Pacific Salmon Fisheries Comm. Progress Report No. 15. 51 p.

In recent years, columnaris disease has been associated with serious pre-spawning mortality of adult sockeye salmon in several spawning areas of the Fraser River system. This report discusses historic occurrences and etiology of columnaris disease, the source of infection and incidence of the disease among Fraser River sockeye spawners, and the potential control of mortality through water temperature regulation. (Authors)

9246. Waters, Thomas F. (Dept. of Entomology, Fisheries and Wildlife, Univ. of Minnesota, St. Paul, Minn.). 1966. PRODUCTION RATE, POPULATION DENSITY, AND DRIFT OF A STREAM INVERTEBRATE. Ecology, 47(4): 595-604.

Production rates of the stream mayfly, Baetis vagans McDunnough (Ephemeroptera: Baetidae), were estimated by two different methods, compared and related to population density and drift rate. In the year of study, this mayfly had two summer generations and one winter generation. The two production rate methods yielded estimates of 9.1 and 12.6 g/m^2 year as the sum of the three generations, although both estimates were minimal. Production rates for the summer generations were higher than for the winter generation, although winter production was still at a significant level. The summer generations drifted in large quantities, up to about 22 g/day, but the winter generation appeared to drift little, if any, until near the end of the generation in early spring. The relation between annual production rate and mean population density, or turnover ratio, was 9.7, or 3.2 times the number of generations. (Auth.)

9247. Johnson, C. M., and P. R. Needham (Dept. of Soils and Plant Nutrition and Dept. of Zoology, Univ. of California, Berkeley, Calif.). 1966. IONIC COMPOSITION OF SAGEHEN CREEK, CALIFORNIA, FOLLOWING AN ADJACENT FIRE. Ecology, 47(4): 636-639.

Samples of water from Sagehen Creek, California, were collected at 2-week intervals for 2 years following the Donner Ridge forest fire which burned over the lower part of Sagehen Basin in 1960. Sampling sites included a spring which feeds the stream above the burned area and two sites in the stream, one above the burned area below the spring, the other within the burned area. Analyses included pH, bicarbonate, calcium, magnesium, sodium, and potassium. Seasonal variation in ionic composition was observed at both stream sampling sites. In contrast to the constant composition of the spring water for the 2-year period, the ionic concentrations in the stream samples were inversely related to streamflow. In the summer, streamflow was low and stream ionic concentrations equalled or exceeded those of the spring water. During periods of runoff from melting snow, March to June, streamflow increased greatly and ionic concentrations decreased. There was no specific effect of the fire on the ionic composition of the stream. It is postulated that ash constituents were dissolved by light rainfall and leached into the permeable forest soil before the first snow. Because of the acidic nature of the soil the dissolved cations were adsorbed on the exchange complex rather than washed directly into the stream. (Authors)

9248. Hughes, G. M. 1966. THE DIMENSIONS OF FISH GILLS IN RELATION TO THEIR FUNCTION. J. Exper. Biol., 45(1): 177-195.

Measurements were made of the gill areas of 14 species of British fish and the Antarctic icefish, Chaenocephalus. The different parameters of the gill sieve were considered quantitatively in relation to the size of the gill area, resistance to the passage of water, and the diffusion conditions at the gills. From calculations of the expected flow through a sieve of the measured dimensions it was concluded that a sufficient volume will pass in the inter-lamellar spaces despite their fine dimensions. Differences in the nature of the sieve relative to the theoretical one and changes during the respiratory cycle account for the ventilation volumes measured being less than those calculated. It is concluded that more active fish not only have larger gill areas but that the conditions for gaseous exchange are

better than for more sluggish forms and that the area is increased in such a way as to minimize the resistance to flow. This is mainly achieved by having an increased total filament length and a large number of secondary folds. Sluggish fish have more widely spaced and higher lamellae and their total filament length is reduced. The resistance to flow relative to the area is less in these forms than in the more active species. Consideration is given to the different pathways along which water can infiltrate past the respiratory epithelium and analogies are drawn with the alveolar air, and the physiological and anatomical dead-spaces of the mammalian lung.

9249. Howard, John K., and Shoji Ueyanagi (Inst. of Marine Science, Univ. of Miami, Miami, Fla.). 1965. STUDIES IN TROPICAL OCEANOGRAPHY NO. 2. DISTRIBUTION AND RELATIVE ABUNDANCE OF BILLFISHES (ISTIOPHORIDAE) OF THE PACIFIC OCEAN. Univ. of Miami Press, Inst. of Marine Science. 134 p. Pr. $5.50.

The billfishes (Istiophoridae) are the basis of certain locally important fisheries and are important adjuncts to other large fisheries, such as the Japanese longline fishery. Istiophoridae occur over the entire Pacific between 40° N and 40° S latitudes, although the area occupied in greatest abundance differs for each species. Black marlin and sailfish have their greatest abundance near land masses and striped marlin, blue marlin and shortbill spearfish occur more commonly in the open sea. The striped marlin is distributed in a horseshoe-shaped pattern. Those at the apex of the horseshoe, the Eastern Pacific, are believed to be closely related to those of the South Pacific. Northern and southern populations appear distinct, though some interchange may occur. The blue marlin is the most tropical species and is considered to belong to one population. It follows a seasonal north-south migration across the equator. The black marlin is characterized by having its greatest density on the periphery of the area, the Indo-Australian area and the Eastern Pacific. It is sparse in open sea areas. The sailfish is most abundant near the Solomon Islands, New Guinea, the Caroline Islands, in the Kuroshio Current and along the coast of Central America. Data are scarce for shortbill spearfish. Its density appears highest in the areas where distributions of striped marlin and blue marlin overlap. An atlas of 38 maps showing the distribution and relative abundance of billfishes of the Pacific Ocean accompanies the report.

9250. Shannon, Walter S. 1967. FOREST PRACTICES AND WATERSHED MANAGEMENT IN CALIFORNIA. American Forests, 73(5): 6-7, 48, 50, 52-55.

Data on 33 streams damaged by 1962 logging. A total of some 55 stream miles were damaged mainly by physical destruction of the stream channel or by sedimentation of gravels. Logging roads, skid trails, and landings located in the streambed or on its banks are particularly bad. Sediment fills the spaces among the rocks in the riffles, the main food-producing area of a stream.

9251. Dechtiar, Alex (Research Branch, Ontario Dept. of Lands and Forests, Maple, Ont., Canada). 1967. Neoechinorhynchus notemigoni N. SP. (ACANTHOCEPHALA: NEOECHINORHYNCHIDAE) FROM GOLDEN SHINER OF LAKE ONTARIO. Canadian J. Zool., 45(2): 155-159.

A new species of acanthocephalan, Neoechinorhynchus notemigoni, from the intestine of Notemigonus crysoleucas (Mitchill) is described. This is the 23rd species of the family Neoechinorhynchidae Van Cleave, 1919 and the 15th species of the genus Neoechinorhynchus Hamann, 1892, known from North American fish described by various authors. It is the sixth species of the genus Neoechinorhynchus which does not utilize catostomids as definitive hosts in North America. (Auth.)

9252. Anderson, P. D., and H. I. Battle (Dept. of Zoology, Univ. of Western Ontario, London, Ont., Canada). 1967. EFFECTS OF CHLORAMPHENICOL ON THE DEVELOPMENT OF THE ZEBRAFISH, Brachydanio rerio. Canadian J. Zool., 45(2): 191-204.

Fertilized eggs of the zebrafish, Brachydanio rerio, were subjected at 26° C to three concentrations of chloramphenicol, 0.125, 0.250, and 0.500 mg/ml, at

seven developmental stages ranging from cleavage to optic cup formation for periods of 12, 24, and 36 hr. Subsequently, they were transferred to aquarial water to complete 48 hr of development. Most extreme anomalies were induced by chloramphenicol in eggs initially subjected during cleavage and blastulation and less extreme anomalies in eggs exposed during or after gastrulation. In addition to general retardation of development, anomalies of the nervous, muscular, and vascular systems were induced. A unique type of spina bifida was of frequent occurrence. The teratogenic responses of the zebrafish egg are discussed in relation to the present concept of the mode of action of this antibiotic. (Authors)

9253. Sale, Peter F. (Dept. of Zoology, Univ. of Hawaii, Honolulu, Hawaii). 1967. A RE-EXAMINATION OF THE TAXONOMIC POSITION OF THE AURORA TROUT. Canadian J. Zool., 45(2): 215-225.

Results of a field study are used in considering the taxonomic position of the aurora trout. Coloration and morphology of aurora and brook trout are compared. There are at best only minor differences—in some aspects of coloration, in epidermal thickness, and in behavior—between these fish. These differences are genetically controlled. Aurora trout fill the brook trout niche in lakes which they inhabit. Characteristics of the home range lakes are given. Aurora and brook trout are fully interfertile, but reproductively isolated sympatric populations existed in one lake. It is suggested that the aurora trout is a race of the brook trout worthy of nomenclatural recognition as a subspecies, and that it should be classified as Salvelinus fontinalis timagamiensis Henn and Rickenbach. (Auth.)

9254. Alperin, Irwin M. 1966. DISPERSAL, MIGRATION AND ORIGINS OF STRIPED BASS FROM GREAT SOUTH BAY, LONG ISLAND. New York Fish and Game Jour., 13(1): 79-112.

To evaluate the potential of Great South Bay as an area for developing a sport fishery for striped bass, 1,917 fish were seined and tagged there from 1956 to 1961, mostly during May and June of 1960 and 1961. They were predominantly ages II, III, and IV, and few year classes were represented. Of 281 recoveries, 63.0 percent were from New York, 11.0 percent were from New England and 26.0 percent from areas south of New York. In New York, more came from eastern than from western Long Island waters, and only 2.4 percent were from the Hudson River. Evidence is presented indicating that the irregular presence of large numbers of striped bass in Great South Bay is related to the appearance of fish from dominant year classes originating outside the State, probably in the Delaware Bay—Chesapeake Bay region. When emigration from the south does not occur to any extent, the principal source of the bay stock may be striped bass of Hudson River origin. The data indicate that striped bass are present in Great South Bay primarily during May and June. On such occasions, young fish predominate and, at times, about half may have reached legal size. There is reason to believe that a sport fishery might be developed to harvest these fish, particularly if the size limit were reduced. (Auth.)

9255. Alperin, Irwin M. 1966. OCCURRENCE OF YEARLING STRIPED BASS ALONG THE SOUTH SHORE OF LONG ISLAND. New York Fish and Game Jour., 13(1): 113-120.

Yearling striped bass are rarely encountered along the northeastern Atlantic coast because fish of this species characteristically do not migrate far from their spawning grounds before reaching 2 years of age. In June and July of 1964, schools of yearling striped bass appeared at several locations along the south shore of Long Island where they frequented freshwater environments. Several specimens that were collected proved through meristic character analysis to be most closely related to Hudson River stock, and this was presumed to have been their origin. The presence of these yearlings can in no way be construed to have represented local spawning. (Auth.)

9256. Scott, W.B., and S.N. Tibbo. 1965. UNUSUAL PELAGIC FISHES OF THE NORTHWEST ATLANTIC. Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N.B., General Series Circular No. 49. 5 p.

9257. Anonymous. 1966. SOUTHWEST GROPES FOR NEW WAYS TO END WATER SHORTAGE. U. S. News and World Report, 61(24): 59-61.

At a meeting in Albuquerque it was indicated that future impoundment of rivers in the southwest was usually not feasible. Development of hydroelectric power has assisted in the financing of federal irrigation developments, but now electrical plants using coal or atomic energy are becoming more and more economical. There is strong feeling against the Bureau of Reclamation developing power by coal or atomic energy to assist in funding its irrigation project.

9258. McClane, A. J. 1967. WHERE DO WE GO FROM HERE? Field and Stream, 71(10): 10-12, 14, 16, 125-129.

What may prove to be a pesimistic, realistic, or optimistic forecast of sport fishing in the United States during the remainder of this century. Great strides are being made in the management of sport fish, but the deteriorating environment in which fish must live tends to more than nullify these efforts. Impoundments are providing much of the fishing once found in natural lakes and streams. Even under contemplated intensive management it is questionable if fluctuating reservoirs will provide the quality of fishing of natural waters. Salt-water fishing prospects are also bleak. New and particularly destructive methods of commercial fishing by Eurasian peoples are affecting the population of game species. The profits being realized from the conversion of estuarine habitat to pleasure boat canals and housing sites is rapidly reducing important nursery grounds of many marine species. The desire for water-based activities may lead housing development planners to include the construction and management of a clean water area as the focus for each development.

9259. Caillouet, Charles W., Jr. 1967. HYPERACTIVITY, BLOOD LACTIC ACID AND MORTALITY IN CHANNEL CATFISH. Agriculture and Home Economics Experiment Station, Iowa State Univ. of Science and Technology, Ames, Iowa, Research Bulletin 551. pp. 898-915.

Mortality in submature channel catfish, Ictalurus punctatus (Rafinesque), caught in the Mississippi River and stocked in Iowa streams and ponds, led to this investigation in 1961-1963. The major findings can be summarized as follows: The mean concentration of lactic acid in the blood of unexercised channel catfish varied from 2.3 to 7.6 mg/100 ml of whole blood. That of fish subjected individually to forced exercise varied from 21.1 to 44.1 mg/100 ml after 5 minutes of exercise and from 59.1 to 67.6 mg/100 ml after 15 minutes of exercise. A lower concentration of lactic acid, 28.2 mg/100 ml, for fish exercised 15 minutes in a group indicates that fish exercised in a group were not subjected to as strenuous muscular activity as were those exercised individually. Mean lactic acid values were usually greater at higher temperatures, both for unexercised and exercised fish. The degree of muscular activity manifested by individual fish during forced exercise decreased during exercise. The fish were judged exhausted in an average of less than 5 minutes. The average time required for exhaustion was less at higher temperatures. Capturing catfish with electric shocker or hoop nets and subsequent handling of the fish elevated the lactic acid concentration of the blood to a greater extent than did forced exercise for 15 minutes. Fatigue, loss of equilibrium and mortality were associated with high mean values of lactic acid in fish collected with hoop nets. Variation in lactic acid concentration among individual fish increased during forced muscular activity. It was hypothesized that such variation might result from differences among individuals in muscle glycogen concentration before activity or differences in fitness among individuals or both. (Auth. summ.)

9260. Atherton, Maxine. 1966-67. FISHING ON GOVERNMENT WATERS IN "LA BELLE PROVINCE". The Atlantic Salmon Journal, Winter 1966-67. pp. 3-7.

The Quebec plan for management of some salmon rivers by the public. Licensed salmon fishermen pay a daily fee (residents $4, non-residents $10) and obey the fishing rules. There are over 50 salmon rivers in Quebec and some have been neglected under the governments lease system. Some of these leases have been rescinded and are open to the public. The author thought for years that the

only hope for the sport was to keep the salmon waters in the hands of private clubs or individuals. Now she thinks that some government management will work.

9261. Carter, Wilfred M., and Joan Heyland. 1966-67. QUEBEC'S SALMON STATISTICS 1965. The Atlantic Salmon Journal, Winter 1966-67. pp. 14-21.

An estimate of the harvest of sport and commercial salmon and the seasonal distribution of angler catch and angler use of the salmon rivers.

9262. Robinson, Jordan A., and Fred P. Meyer (Bur. of Sport Fisheries and Wildlife, Fish Farming Experimental Station, Stuttgart, Arkansas). 1966. STREPTOCOCCAL FISH PATHOGEN. Jour. of Bacteriology, 92(2): 512.

Golden shiners were found infected with a group B, γ-hemolytic Streptococcus sp. Diseased fish had raised, inflamed areas along the dorso-lateral portions of the body. The disease was highly contagious and generally proved fatal to all fish of infected lots within 48 to 72 hours.

9263. Gordon, Malcolm S. 1964. ANIMALS IN AQUATIC ENVIRONMENTS: FISHES AND AMPHIBIANS. In: Handbook of Physiology. Section 4: Adaptation to the Environment. D. B. Dill, Section Editor. American Physiological Society, Washington, D. C. pp. 697-713.

Physiological ecology of the osmotic and ionic regulatory mechanisms is the central theme. Fish groups discussed include the hagfishes, lampreys, bony fishes, crossopterygians, lungfishes and elasmobranchs. Defines the limits of present knowledge and indicates some of the things which should be determined. Provides a list of 119 references.

9264. Fry, F. E. J. 1964. ANIMALS IN AQUATIC ENVIRONMENTS: FISHES. In: Handbook of Physiology. Section 4: Adaptation to the Environment. D. B. Dill, Section Editor. American Physiological Society, Washington, D. C. pp. 715-728.

This chapter covers the temperatures in the aquatic biotype, lethal limits of temperatures, thermal preferences, and the influence of temperature on activity and metabolism. Provides a list of 98 references.

9265. Cooper, Gerald P. 1966. FISH PRODUCTION IN IMPOUNDMENTS. Michigan Dept. of Conservation Research and Development Report No. 104. pp.1-21.

Impoundments in temperate North America are of all sizes from 1-acre farm ponds to 1,000-acre hydroelectric and recreational impoundments to very large flood control reservoirs of 500 square miles or more. These waters are open to sport fishing; a few of the largest are also open to commercial fishing. Productivity of a reservoir depends on: (1) nutrients in inflow waters; (2) nutrients from reservoir basin soils; (3) rate of volume displacement in the reservoir; and (4) character of the plant-animal food chain which is dominant. Reservoirs lose their high initial fertility in 5 to 10 (up to 25) years. Nutrients in the new impoundment become locked up in bottom deposits or are lost to outflow or to fish harvest. Or deterioration may be toward acid bogs, as with some beaver dams. Or the fish population usually changes, from good fish growth and a favorable predator-prey ratio, to poor growth and a decline in predator fish. Reservoirs produce more fish than do natural lakes. The standing crop of fish averages 50-150 pounds per acre in natural lakes, 200-400 pounds per acre (2 to 8 times as much) in impoundments. A large part of the food chain is from plankton and insects to centrarchids and perch; less is from plankton to minnows and suckers to large predators. Best predators are the northern pike in the northeast, the largemouth bass and white bass in the south, and large salmonids in the west. Periodic drawdown may be the best way to manage impoundments for fish. Aeration of basin sediments helps to keep nutrients in the food chain. Any crop of herbaceous terrestrial plants is good organic fertilizer when that part of the basin is reflooded. Disruption of rooted aquatic plants reseases nutrients which might better go into other links of the fish food chain. Fluctuation of level dislodges prey species from ecological niches, resulting in more predation, lower population density and better growth rate of sunfishes and perch; this improves the sport fish population. (Auth.)

9266. Hubbell, Grace G. 1966. A BIBLIOGRAPHY WITH ABSTRACTS OF THE LITERATURE ON ECOLOGY OF IMPOUNDMENTS. Michigan Dept. of Conservation Research and Development Report No. 104. pp. 1-70.

9267. Stout, Wendell H., and Ralph A. Grenfell. 1966. OPOSSUM SHRIMP COLLECTION. Oregon State Game Comm. Habitat Improvement Project No. 20. 7 p.

Opossum shrimp Mysis relicta were collected in Upper Waterton Lake, Alberta, Canada, in the summer of 1966 for the second successive year. Approximately 650,000 were collected and introduced into Waldo, Wallowa, Big Cultus, Crescent, and Timothy Lakes in Oregon to improve the fish-producing capacity of these oligotrophic waters. (Authors)

9268. Lesser, Charles A. (Delaware Game and Fish Comm., Dover, Del.). 1966. AQUATIC VEGETATION SURVEY. Delaware Game and Fish Comm. Federal Aid in Fish Restoration, Project No. F-21-R. 65 p.

Fifty-five freshwater impoundments were surveyed for identification of aquatic vegetation and weed problems. Spatterdock was the most predominant plant and presented a weed problem to fishermen in a few impoundments. Submerged vegetation caused fewer problems than emergent. Bladderwort was the most abundant submerged plant. In all of the impoundments studied, sedimentation has significantly decreased water depths since their origin. Portions of many of the ponds have now become marshy. Higher water levels or dredging would be required to regain the water area lost to encroaching marshes. The impoundments on watersheds which receive effluents from food processing and sewage treatment plants generally have waters with periodic high plankton blooms and some algae problems. Those impoundments which do not receive that type of effluent have more luxuriant vegetation and more aquatic weed problems. (Auth.)

9269. Charles, James R. (Dept. of Fish and Wildlife Resources, Frankfort, Ky.). 1966. EFFECTS OF COAL-WASHER WASTES ON BIOLOGICAL PRODUCTIVITY IN MARTIN'S FORK OF THE UPPER CUMBERLAND RIVER. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 27. 47 p.

Intermittent coal-washer waste pollution has been and continues to be a chronic stream pollution problem in the coal-producing areas of Kentucky despite passage of "model" anti-pollution laws. The effects of coal-washer wastes — primarily coal dust and "fines" — on the water quality, macro-invertebrate bottom fauna, and fish fauna of a stream in Harlan County were determined and evaluated by a study that began in the summer of 1961 and continued through 1963. Martin's Fork of the upper Cumberland River was intermittently polluted by washer wastes emanating from two coal mines three miles apart on the watershed. Turbidity at the five sampling stations in the polluted section fluctuated widely, dependent upon coal-washing schedules. The range was from 0 to 700 ppm. Practically all the other chemical characteristics monitored in the polluted section exceeded the values found in the clean-water section above the washer effluent. A moderately diverse macro-invertebrate bottom fauna was found in both the clean-water and polluted sections; however, the quality of the fauna as potential fish food was distinctly poorer in the polluted section. Annual mean productivity in the clean-water section varied from 42 to 81 organisms per square foot and from 0.69 to 1.58 cubic centimeters per square foot. The overall 3-year mean was 52 organisms and 0.82 cc. The range in the polluted section was from 19 to 183 organisms and from 0.17 to 4.26 cc per square foot. The overall 3-year mean was 52 organisms and 0.59 cc, the same and about three-fourths, respectively, of the clean-water production rate. Population sampling showed that the fish fauna of Martin's Fork is meager, compared to many other streams in Kentucky having more diverse habitat types. Only 37 of the more than 178 species known to occur in the state were found. Specimens of redeye bass, Micropterus coosae, a species not known to occur in Kentucky, were found in the upper reaches of Martin's Fork. From 3 to 13 of the 25 to 31 fish species found each year in the clean-water section occurred there exclusively. The polluted section supported annually between 19 and 25 species, from 1 to 6

being found there exclusively each year. The average annual standing crop in the clean water ranged between 35 and 53 pounds per acre. The polluted section supported a standing crop that ranged between 62 and 103 pounds per acre. Harvestable-size channel catfish primarily, and intermediate-size suckers secondarily, were responsible for the greater biomass in the polluted section. (Auth.)

9270. Henley, James P. (Dept. of Fish and Wildlife Resources, Frankfort, Ky.). 1966. LAKE CUMBERLAND INVESTIGATIONS. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 28. 26 p.

A total of 13 fish population samples were made in 1952-55 and 42 samples were made in 1960-64. The carrying capacity of the reservoir was reached in 1954. The standing crop increased from 39.9 pounds per acre in 1952 to a high of 193.6 pounds per acre in 1955. The standing crop of fish present in the lake during the period 1960-64 varied from a low of 91.7 pounds per acre in 1964 to a high of 175.3 in 1960 and 174.5 pounds per acre in 1963. Following the establishment of threadfin shad in the reservoir in 1960, the gizzard shad have not produced a successful spawn and the threadfin shad has replaced the gizzard shad as the principal forage species in the reservoir. A sport fishery for rainbow trout Salmo gairdneri has been created in Lake Cumberland and the growth of the planted trout has been rapid. (Auth.)

9271. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF SHANTY HOLLOW LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 31. 27 p.

Physical, chemical, and biological studies were conducted at Shanty Hollow Lake from 1958 through 1965. A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was usually evident by the latter part of May, when the thermocline was located between 7 and 11 feet. Autumnal mixing was completed by November when a near-homothermic condition was found. Mean monthly dissolved oxygen profiles show this characteristic to be present in amounts adequate for fish survival (above 5 ppm), to a depth of 10 feet during all sampling periods. It became void in the lower depths during July, August, and September. Annual maximum, mean, and minimum values for total alkalinity, total phosphates, pH, and free carbon dioxide are given. Population studies indicated a widely fluctuating fish population. The average standing crop varied from 49 pounds per acre in 1959 to 200 pounds per acre in 1961; then it dropped to 67 pounds per acre in 1962 and went back up to 180 pounds per acre in 1965. The creel survey studies showed an increasing harvest from 1958 to 1964. During 1965 the harvest dropped, however there were approximately three times as many pounds of fish harvested during that year as compared to 1958. From 1961 to 1964 the lake provided some of the best bluegill fishing in Kentucky. The fertilization studies indicated a substantial increase in the quality and quantity of the fishery during the years (1960-1965) when an inorganic fertilizer was applied monthly at the rate of 40 pounds per acre (April-September). (Auth.)

9272. Pfeiffer, Peter W. 1967. SOME PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS OF GREENBO LAKE. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 32. 27 p.

Physical, chemical, and biological studies were conducted at Greenbo Lake from 1958 through 1966. A bathymetric map of the lake is presented. Other physical data are given which include surface area, shoreline mileage, volume, and mean and maximum depth. Mean monthly temperature profiles are presented. Stratification was usually evident by early May when the thermocline extended from 9 to 17 feet. Fall overturn was complete by late October. Mean monthly dissolved oxygen profiles show this characteristic to be present in amounts adequate for fish survival (3 ppm) to a depth of 20 feet during all sampling periods. It became void in the lower depths from July through November. Annual maximum,

mean, and minimum values are given for total alkalinity, total phosphates, pH, and free carbon dioxide. Population studies indicated an improving fish population from 1958 to 1965. The average standing crop increased from 70 pounds per acre in 1958 to 188 pounds per acre in 1965. There were approximately 55 pounds per acre more fish of a size desirable to the angler in 1965 than there were in 1958. Creel survey studies showed an increasing harvest from 1958 to 1962, and a decreasing harvest from 1962 to 1965. However, there was a steady improvement in the average quality of each fish taken from 1958 to 1965. The fertilization studies indicated a good increase in the quality and quantity of the fishery during the years when an inorganic fertilizer (20-20-5) was applied at the rate of 40 pounds per acre per application. (Auth.)

9273. Carter, Bernard T. (Dept. of Fish and Wildlife Resources, Frankfort, Ky.). 1967. GROWTH OF THREE CENTRARCHIDS IN LAKE CUMBERLAND, KENTUCKY. Kentucky Dept. of Fish and Wildlife Resources, Fisheries Bulletin No. 44. 30 p.

Growth characteristics of the largemouth bass, the Kentucky bass, and the white crappie and the changes that occurred in these characteristics during the first five years of impoundment of Lake Cumberland are reported in this paper. A description of the pattern of early scalation and the length of the fish at which scalation is completed is given for the largemouth bass and the white crappie. Length-weight-age distribution of each species is discussed in terms of harvestability. (Auth.)

9274. Anonymous. 1967. CLINCH RIVER STUDY. U.S. Atomic Energy Comm., Oak Ridge National Laboratory, Oak Ridge, Tenn. ORNL-4035. UC-70 — Waste Disposal and Processing. 121 p.

Results of a 5-year study of the effects of low concentrations of radionuclides released into a freshwater stream.

9275. Lacroix, Yves, and Dirk Casagrande. 1966. STUDY OF EXISTING SMALL DAMS IN VIEW OF IMPROVING DESIGN AND CONSTRUCTION PRACTICES. Illinois Dept. of Conservation, Small Dams Engineering Project FA Illinois, F-17-R-1. 33 p. tables, illus.

A study of existing small dams has been made with the intent to recommend methods of improving design and construction practices. After a description of the general characteristics of six of the small dams under the jurisdiction of the Department of Conservation of the State of Illinois, the writers review the procedures generally followed during the feasibility study, during the design and the construction stages, and for the maintenance of these dams. A review is made of some typical items covered in the plans and specifications and of the design analyses concerning stability and seepage. Comments are offered concerning the extent of the subsurface exploration and several design details, such as site preparation, cutoff, drainage trench, and drainage blanket. The criteria for selection of embankment materials, granular materials, and riprap, and for the placement and compaction of these materials, are analyzed. Recommendations are offered concerning supervision and soil testing during construction, installation and reading of instrumentation, and maintenance; also some covering details of design, construction, and maintenance.

9276. Mount, Donald I. (Fed. Water Pollut. Control Admin., Cincinnati Water Research Lab., Cincinnati, Ohio). 1967. CONSIDERATIONS FOR ACCEPTABLE CONCENTRATIONS OF PESTICIDES FOR FISH PRODUCTION. In: A Symposium on Water Quality Criteria to Protect Aquatic Life. American Fisheries Society Special Publication No. 4. pp 3-6.

When water quality requirements for toxic substances for aquatic life are established, they must be designed so that they will protect the organisms under all circumstances of exposure. If we consider the presence of only one pollutant, the most severe conditions will result from continuous exposure; therefore, safe concentrations should not be based on intermittent exposures unless there is a reason for doing so. All quality requirements for aquatic life must protect even the most sensitive developmental stages and the most sensitive species including

necessary food chain organisms. Requirements based on data derived from exposures of at least one generation are minimal; multi-generation exposures are certainly preferable. We should also make clear the obvious but often ignored fact that when more than one pollutant is present, the acceptable concentrations for individual pollutants must be revised. It seems logical that the best and most direct measure of adverse effect from exposure to pollution is the production rate (including growth and reproduction) of the animals that one wishes to harvest. In freshwater, nearly all such animals are fish. In estuarine and marine waters, invertebrates as well as fish are frequently harvested for consumption and recreation. The establishment of satisfactory concentrations of pesticides for fish presents problems such as (1) substantial food-chain accumulation; (2) tissue residues rendering the fish unfit for consumption; (3) potential hazard to the fish from readsorption of fat-stored pesticides; and (4) off-taste or tainting from certain types of pesticides. Concentrations of pesticides in the water that appear to be acceptable under continuous exposure may not be adequate to protect the fish when pesticides are present in their food. Also, unacceptable residues in edible portions may result from exposure of the fish to the water concentrations that are not directly harmful to the fish themselves. Even though in many instances, pesticide contamination in natural waters is intermittent, safe pesticide concentrations should be based on continuous exposure experiments to protect against those instances in which exposure is continuous. (Auth.)

9277. Burdick, G. E. (Pollution Research, New York Conservation Dept., Albany, N. Y.). 1967. USE OF BIOASSAYS IN DETERMINING LEVELS OF TOXIC WASTES HARMFUL TO AQUATIC ORGANISMS. In: A Symposium on Water Quality Criteria to Protect Aquatic Life. American Fisheries Society Special Publication No. 4. pp. 7-12.

Toxic wastes are here defined as all substances derived directly or indirectly from the activity of man that are capable of producing toxic effects to organisms in water. A brief explanation of the intent and procedure of bioassay methods is given. Application factors suggested to derive a safe concentration are discussed and the inapplicability of a uniform factor is pointed out in terms of specific data. Results of bioassay are specific to the water and assay conditions and may not be considered applicable to other waters and other conditions. Because of this, values obtained from assay should never be applied as standards to other waters. Problems in long-term assay are discussed in reference to the water, maintenance of fish supply, desirable oxygen concentration, choice of test organism and simulation of natural conditions. Derivation of toxic concentrations by a more exact mathematical method than the TL_m seems required. The graphical method of Litchfield and Wilcoxon appears to have possibilities for this computation and for the development of a theoretical zero-effect curve. A more refined chemical approach is needed to separate non-toxic, complexed compounds and non-active, absorbed compounds from the active toxicant for the interpretation of toxic effects in natural waters. Bioassays with continuous flow and constant concentration are compared with bioassays with static solutions in terms of the situations to which they are applicable. Other situations may be approached only by the study of natural waters in situ, assisted by continuous monitoring systems now available. Although emphasis should be on the ecological approach, bioassay will still be required under controlled laboratory conditions to interpret the interaction between factors. The eventual attack on long-term toxic effects must be evaluated in terms of the entire ecosystem in addition to the direct toxicological effect on the individual species. (Auth.)

9278. Doudoroff, Peter, and Dean L. Shumway (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1967. DISSOLVED OXYGEN CRITERIA FOR THE PROTECTION OF FISH. In: A Symposium on Water Quality Criteria to Protect Aquatic Life. American Fisheries Society Special Publication No. 4. pp. 13-19.

The rates of growth and embryonic development and the activity of fish can be limited by the supply of oxygen even when dissolved oxygen concentrations are near or above air-saturation levels. Yet, oxygen concentrations well below 3 mg/liter

can be tolerated for long periods by the fish and fish embryos. Fishery biologists should decline, therefore, to specify any particular dissolved oxygen level as a minimal requirement of any fish population or as a proper standard of water quality until the necessary clear guidelines or explicit definitions of terms are provided by pollution-control agencies desiring such simple criteria. The dissolved oxygen level at which growth of fish is limited by the oxygen supply depends on the amount of food available, as well as other environmental factors such as temperature. No reduction of dissolved oxygen below natural levels probably is the only "standard" that would afford complete protection for fishery resources under all circumstances, but adoption of this standard for the regulation of waste disposal usually would be unrealistic and unnecessary. Any lower or less restrictive standards applicable over wide ranges of temperature probably should be expressed as oxygen concentrations (mg/liter) rather than as percentages of saturation. They should be designed to prevent, by limiting diurnal or other fluctuations of dissolved oxygen, frequent exposure of fish to nonlethal but very low dissolved oxygen levels even for periods of moderate duration. The choice of suitable criteria or standards probably should be based in part on bioenergetic considerations relating to fish growth and production rates, but it is not simply and entirely a biological problem, many considerations other than biological ones clearly being pertinent. (Authors)

9279. Mihursky, J. A., and V. S. Kennedy (Natural Resources Inst. of the Univ. of Maryland, Chesapeake Biological Lab., Solomons, Md.). 1967. WATER TEMPERATURE CRITERIA TO PROTECT AQUATIC LIFE. In: A Symposium on Water Quality Criteria to Protect Aquatic Life. American Fisheries Society Special Publication No. 4. pp. 20-32.

The ecological significance of temperature in the aquatic habitat is discussed in relation to the thermal loading of ecosystems by electric power plants. It is pointed out that nuclear plants will produce greater amounts of waste heat per kilowatt of electricity than the conventional fossil fuel plants. Effects of temperature on behavior, metabolism, and mortality of aquatic organisms are described to indicate the difficult problems involved in determining acceptable standards for a healthy fish population. A multivariate analysis of interactions between temperature and other environmental factors is suggested. Standards for temperature regulation are described for three ecosystems: (1) cold-water salmonid streams, (2) warm-water centrarchid environments, and (3) estuaries. (Authors)

9280. Stroud, Richard H. (Sport Fishing Institute, Washington, D. C.). 1967. WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE: A SUMMARY. In: A Symposium on Water Quality Criteria to Protect Aquatic Life. American Fisheries Society Special Publication No. 4. pp. 33-37.

A definition of water pollution must include the factor of impairment of water for any beneficial use by man. Our concern is rightly centered on water quality for maintenance of vigorous populations of aquatic life, especially the fishes. Fishery scientists must be willing to interpret data concerning probable tolerance limits for the critical factors influencing fish life. Exact numerical criteria for most environmental factors are not known at the present time; consequently safety factors must be proposed to allow for variation due to local conditions and unknown interaction. (Auth.)

9281. Hanamura, N. (Hokkaido Regional Fisheries Research Lab., Hakodate, Japan). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 1. SOCKEYE SALMON IN THE FAR EAST. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 1-27.

9282. Ishida, T. (Hokkaido Regional Fisheries Research Lab., Hakodate, Japan). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 2. PINK SALMON IN THE FAR EAST. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 29-39.

9283. Sano, S. (Hokkaido Salmon Hatchery, Sapporo, Japan). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 3. CHUM SALMON IN THE FAR EAST. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 41-57.

9284. Ricker, W. E. (Fish. Res. Bd. Canada Biol. Sta., Nanaimo, B. C., Canada). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 4. SOCKEYE SALMON IN BRITISH COLUMBIA. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 59-70.

9285. Neave, Ferris (Fish. Res. Bd. Canada Biol. Sta., Nanaimo, B. C., Canada). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 5. PINK SALMON IN BRITISH COLUMBIA. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 71-79.

9286. Neave, Ferris (Fish. Res. Bd. Canada Biol. Sta., Nanaimo, B. C., Canada). 1966. SALMON OF THE NORTH PACIFIC OCEAN—PART III. A REVIEW OF THE LIFE HISTORY OF NORTH PACIFIC SALMON. 6. CHUM SALMON IN BRITISH COLUMBIA. Internatl. North Pacific Fisheries Comm. Bull. No. 18. pp. 81-86.

9287. Carmichael, J. W. (Univ. of Alberta, Edmonton, Alberta, Canada). 1966. CEREBRAL MYCETOMA OF TROUT DUE TO A Phialophora-LIKE FUNGUS. Sabouraudia 5(2): 120-123.

Three outbreaks of cerebral mycetoma occurred in fingerling cutthroat trout and lake trout at an Alberta hatchery. Diseased fish lost balance, had erratic movements, later whirled, became lethargic and died. Before death some fish showed exophthalmus and had swellings or ulcers on the head. The fungus caused granulomatous mycetoma of the brain and surrounding tissues. Exophiala salmonis, n. sp. which was isolated from infected fishes was described as the cause of the disease. --S. F. Snieszko.

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